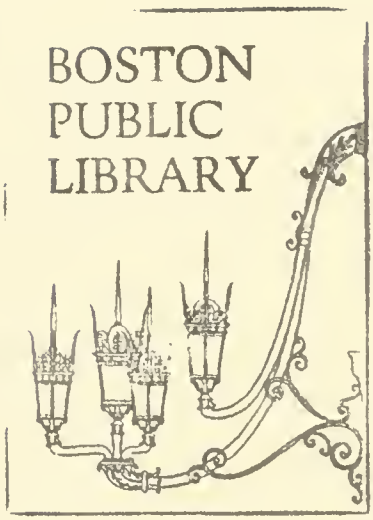
GOVDOC
BRA
921
Final
Vol. 1


BOSTON
PUBLIC
LIBRARY

GOV DOC
BRA
921
Final
Vol. 1

MARKETPLACE CENTER

FINAL ENVIRONMENTAL IMPACT REPORT

VOLUME 1.

OF 3

Waterfront
M 345

FINAL ENVIRONMENTAL IMPACT REPORT

MARKETPLACE CENTER
Boston, Massachusetts
EOEA NUMBER 4389

Prepared For:

MARKETPLACE CENTER ASSOCIATES
189 State Street
Boston, Massachusetts

Prepared By:

MARKETPLACE CENTER ASSOCIATES
189 State Street
Boston, Massachusetts

and

SASAKI ASSOCIATES INC.
64 Pleasant Street
Watertown, Massachusetts

TABLE OF CONTENTS

I. Environmental Notification Form

II. Summary Sheet

III. Description of the Project

IV. Description of the Environment of the Area likely to be Affected by the Proposed Project.

1. Surrounding Area

2. Wind

3. Topography, Geology, and Soils

4. Land Use

5. Archaeology and Historic Land Use

6. Utilities

7. Traffic

8. Air Quality

9. Rare or Unique Aspects of the Site

V. Alternatives to the Proposed Project

VI. Probable Impacts of the Project and its Alternatives on the Environment

1. No Build

2. Proposed Project (Marketplace Center)

A. Surrounding Area
B. Wind Impacts
C. Shadow Impacts
D. Visual Impacts
E. Geologic (construction) Impacts
F. Archaeological Impacts
G. Impacts to Utilities
H. Transportation and Traffic
I. Air Quality
J. Noise
K. Energy Use
L. Special Construction Impacts
M. Setback from Central Artery

VII. Measures to Minimize Environmental Damage

1. Surrounding Area
2. Wind Impacts
3. Shadow Impacts
4. Visual Impacts
5. Geologic Impacts
6. Impacts to Existing Utility Systems
7. Transportation and Traffic Impacts
8. Air Quality Impacts
9. Noise Impacts
10. Energy Use

LIST OF APPENDICES

I. Transportation and Traffic Report

II. Air Quality Report

III. Subsurface Boring Logs

IV. Meeting Notes and Correspondence with Utilities Representatives and the MBTA

V. Wind Study Contract and Pedestrian Level Wind Assessment

VI. Regulations for the Control of Noise in the City of Boston

VII. Archaelogical Report

VIII. Public Comments on Draft and Supplement

IX. Mailing List for Copies of E.I.R.

INTRODUCTION

Marketplace Center is to be built on Urban Renewal Parcel D-10, which is now an open parking lot between the Faneuil Hall Markets and the Central Artery.

The overall development proposal submitted by Marketplace Center Associates was chosen by the Boston Redevelopment Authority after an intensive competition in response to a Developer's "Kit". The physical design proposal presented in this Final Environmental Impact Report is the result of many months of work. It illustrates perfectly how, in an urban setting, design is a true evolutionary process, as this proposal has been shaped by inputs from many public agencies and groups.

In its final form, the Building is quite modest in size, with the office element now only 44% of the height of the Custom House Tower. The three story base element, with two levels of active, first class retail shops, will literally complete the Faneuil Hall Market pedestrian environment without overpowering it in any way. Marketplace Center Associates has committed to pay for all pedestrian improvements (brick and granite paving, lighting, landscaping) in Commercial Street so that this limited access service street, will, like Downtown Crossing, read as a pedestrian preserve. In addition, substantial monies will be spent in improvement to the "Walk-to-the-Sea" under the Central Artery structure and approaching the Waterfront Park.

The exterior materials of the building will be granite and glass, and the granite itself will be chosen so as to match or complement the hues found in the surrounding building.

DESIGN HISTORY

Since the beginning of the MEPA process, the height and massing of Marketplace Center has changed in response to design review comments from a number of agencies, including the Boston Redevelopment Authority, which will retain ownership of the land on which the project is to be built.

In the Environmental Notification Form (ENF) the height was given as "16 to 18 stories", and the office element, which stretched all along the State Street frontage from Commercial Street to the Central Artery, contained typical floors of over 25,000 square feet apiece.

After beginning an intensive design review process with the B.R.A., that agency asked that the office element be moved back from Commercial Street to allow more "breathing space" around the Custom House Tower and to better relate to the granite State Street Block. The typical office floor was reduced to approximately 20,000 square feet and the office element was allowed to go to 21 stories. It was this height which was presented in the Draft Environmental Impact Report on which the extensive wind testing and visual analysis was

carried out.

However, further negotiations with the B.R.A. have now reduced the building to 16 floors, with a maximum height of 220 feet. Since the individual office floors remain at approximately 20,000 square feet, this means that the overall mass and floor area ratio of the building is substantially less than the first submittal to the B.R.A. which formed the basis of the E.N.F.

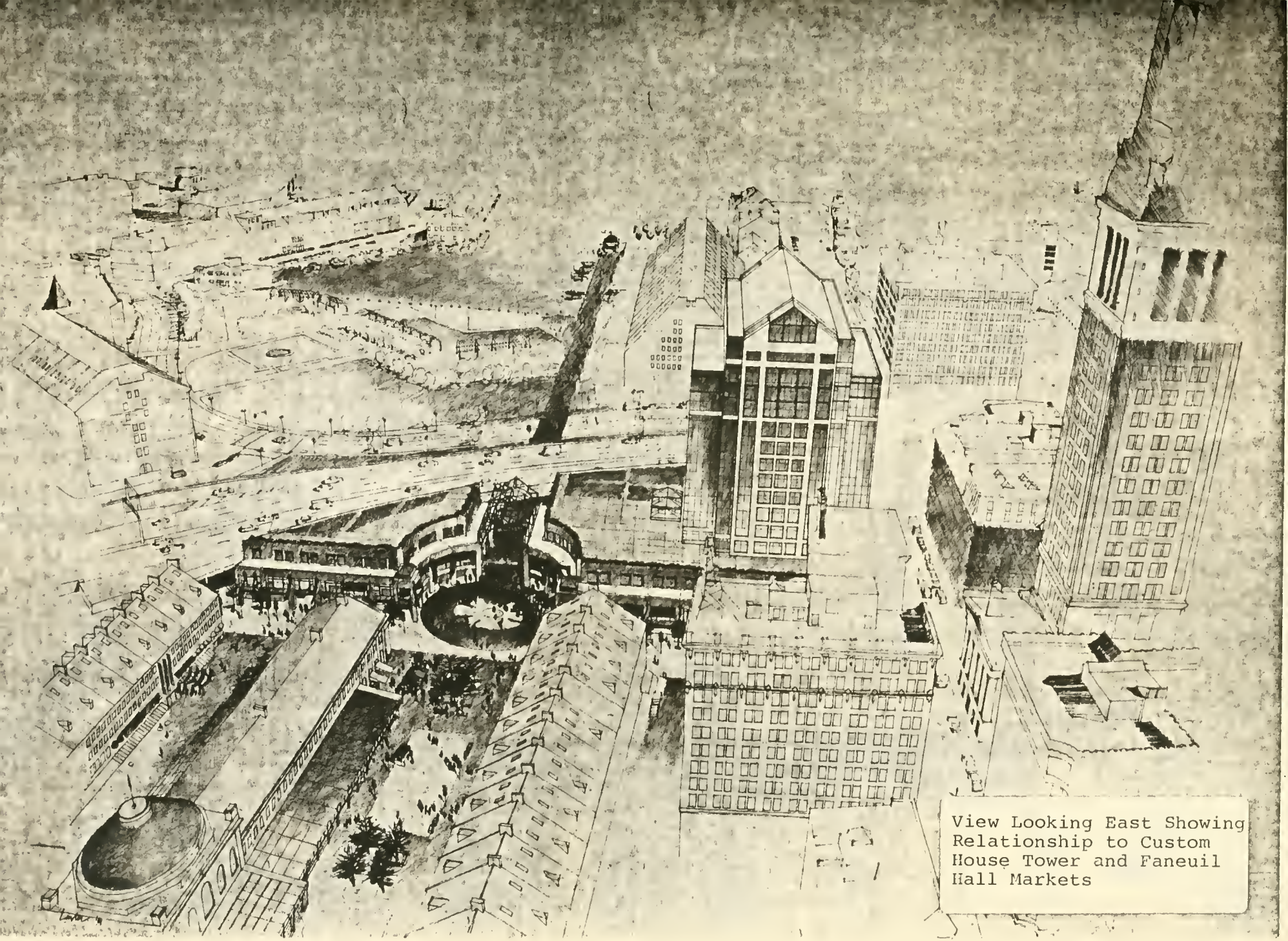
The proposal which is represented in this Final E.I.R. now meets every one of the guidelines contained in the B.R.A. Developer's "Kit".

CONCLUSION

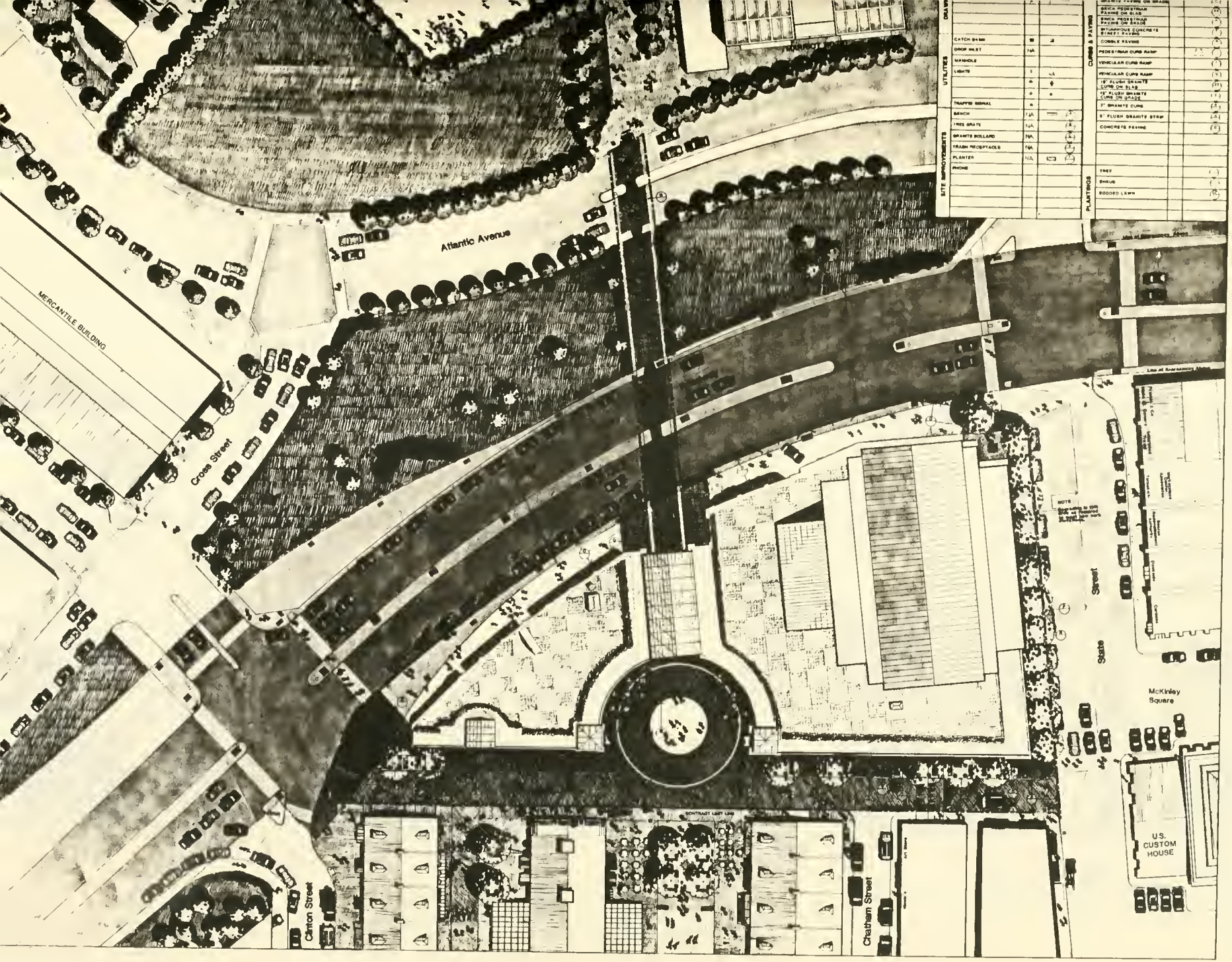
In Marketplace Center Associates' first written submission to the B.R.A., it was stated that:

"Parcel D-10 stands at one of the most critical locations in Boston. It must form an activity center on the "Walk-to-the-Sea", yet it still must encourage pedestrian movement through the site from Faneuil Hall Markets to the Waterfront. It must mask the Central Artery, while at the same time lessen the impact of walking under it. Above all, the building on D-10 must be a distinguished work of contemporary architecture which subtly complements the Faneuil Hall Markets, the Custom House Tower and other neighboring buildings. The tower itself should be elegant yet understated, while, in the base elements there should be the life and vitality which makes the Faneuil Hall Markets so attractive."

Now, over two years later, the following illustrative material shows that these goals have been met, and that Marketplace Center will become a handsome new addition to the fabric of Boston.



View Looking East Showing Relationship to Custom House Tower and Faneuil Hall Markets



WZMH Group Inc
Architects & Planners

Sears Crescent Buildin
Boston, Massachusetts
02108

William Pressley & Associates
Landscape Architects

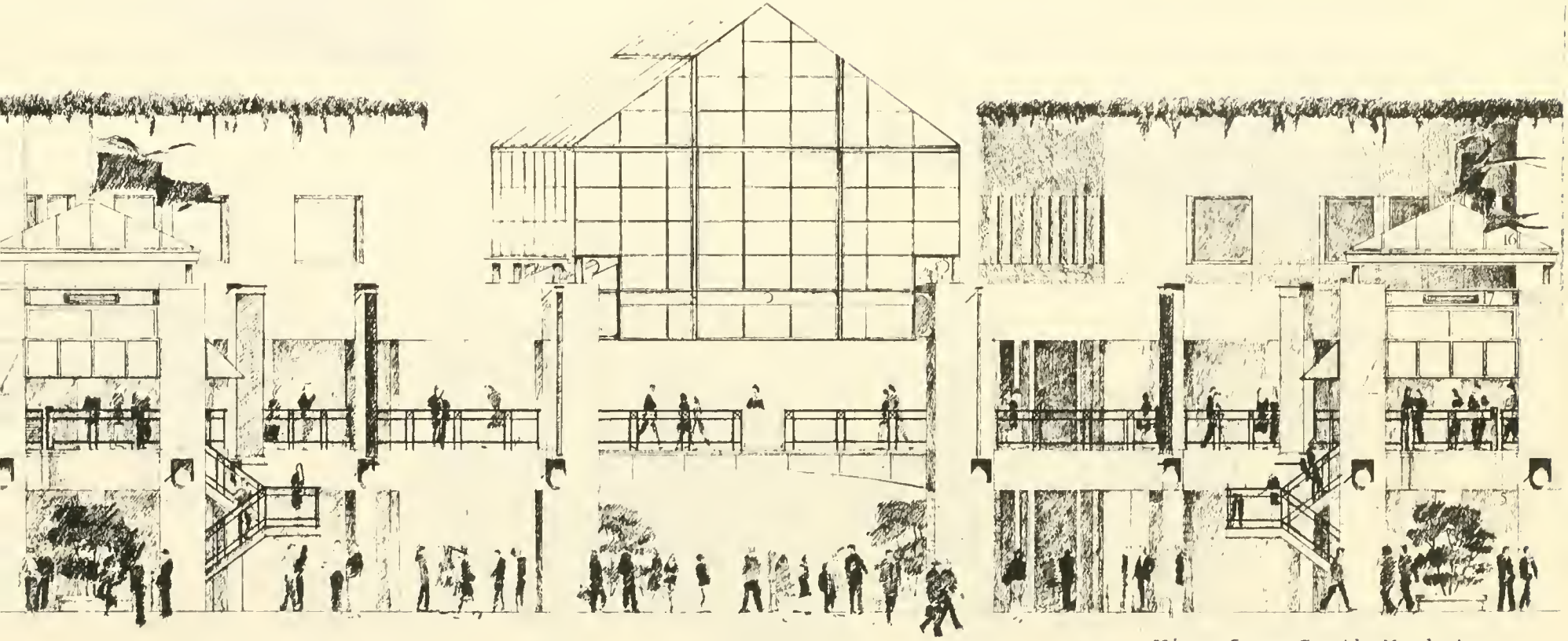
MARKETPLACE CENTER

Marketplace Center Associates
Boston, MA

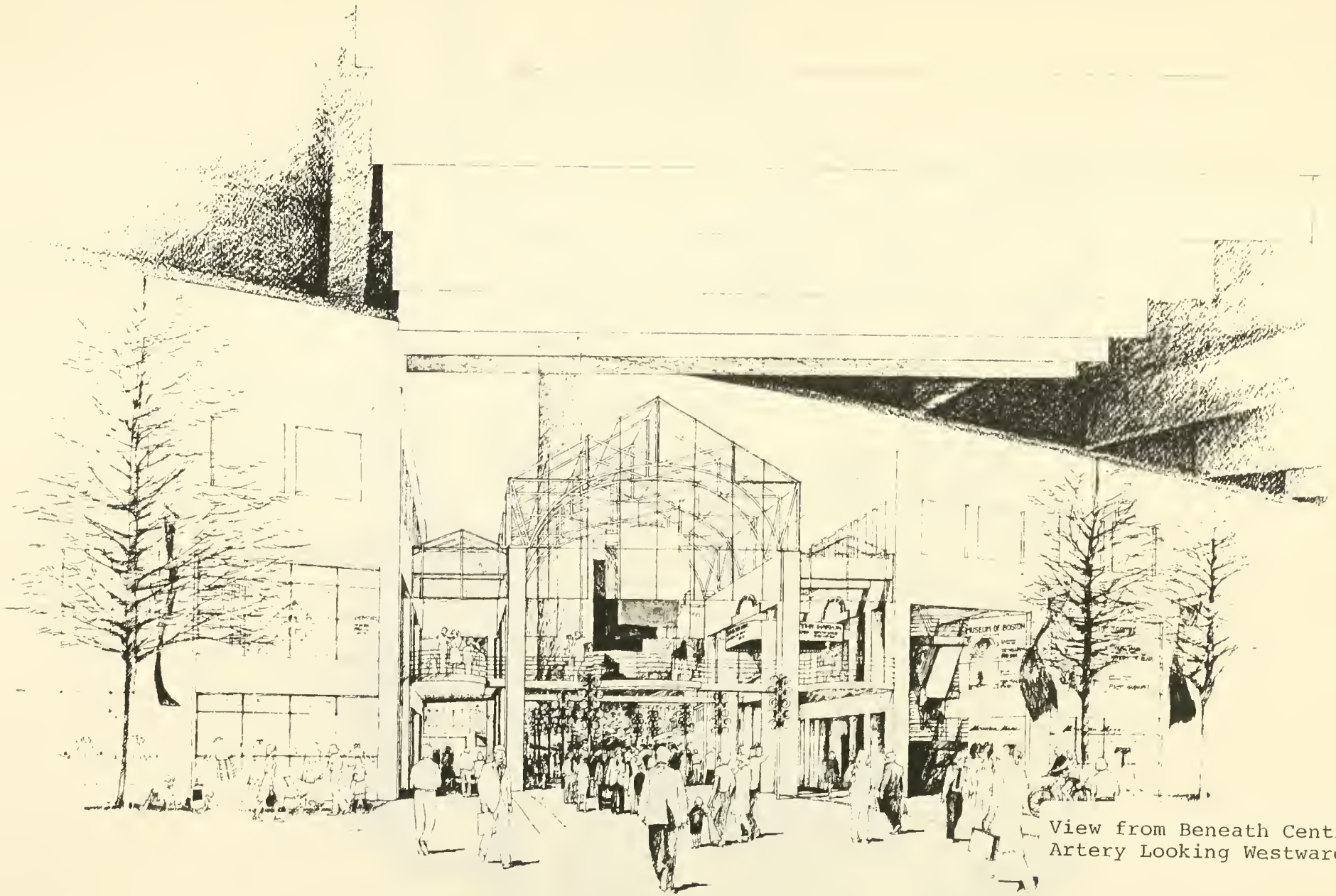
DRAWING TITLE
Site Improvements Plan

SCALE 1"=20'-0"

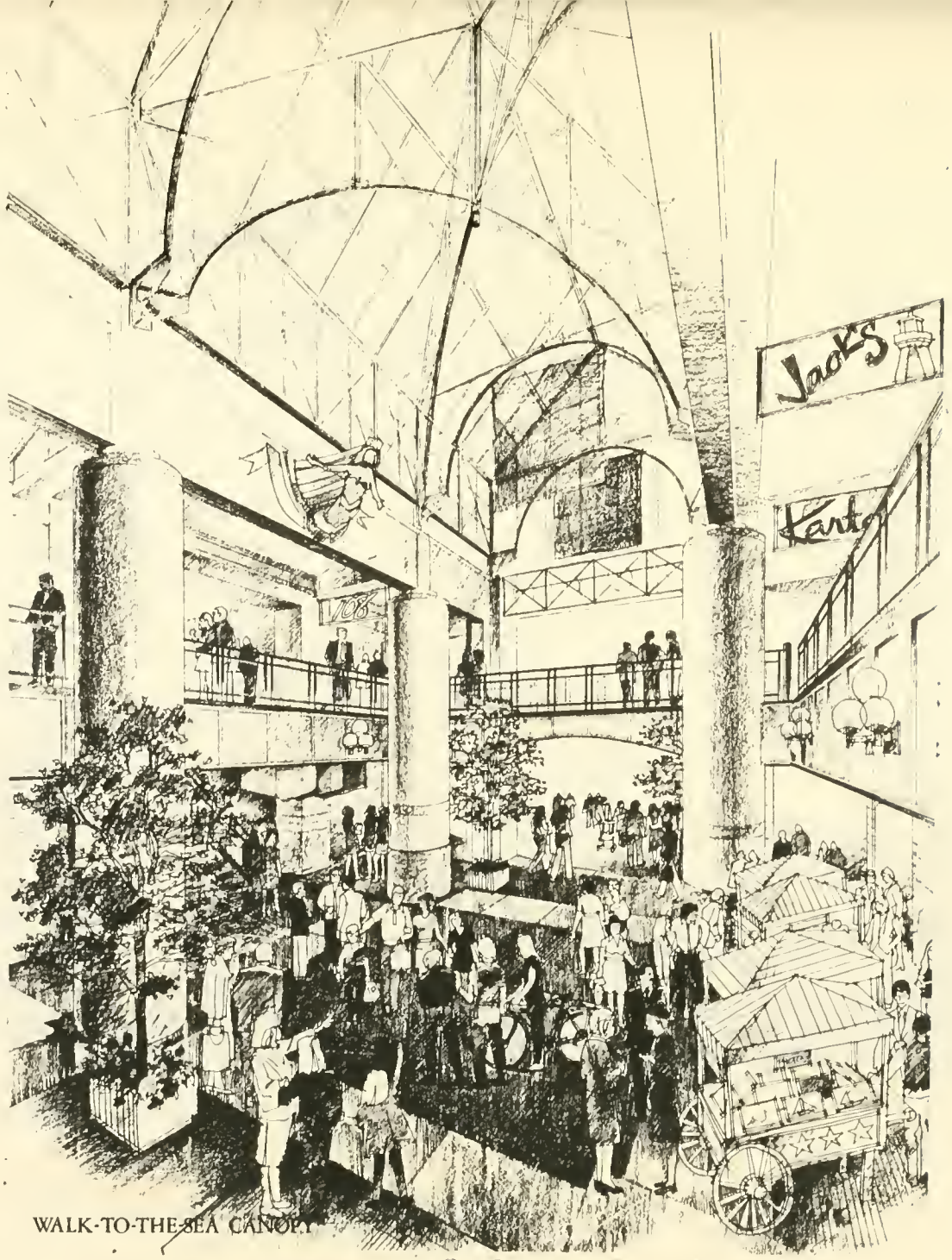
221



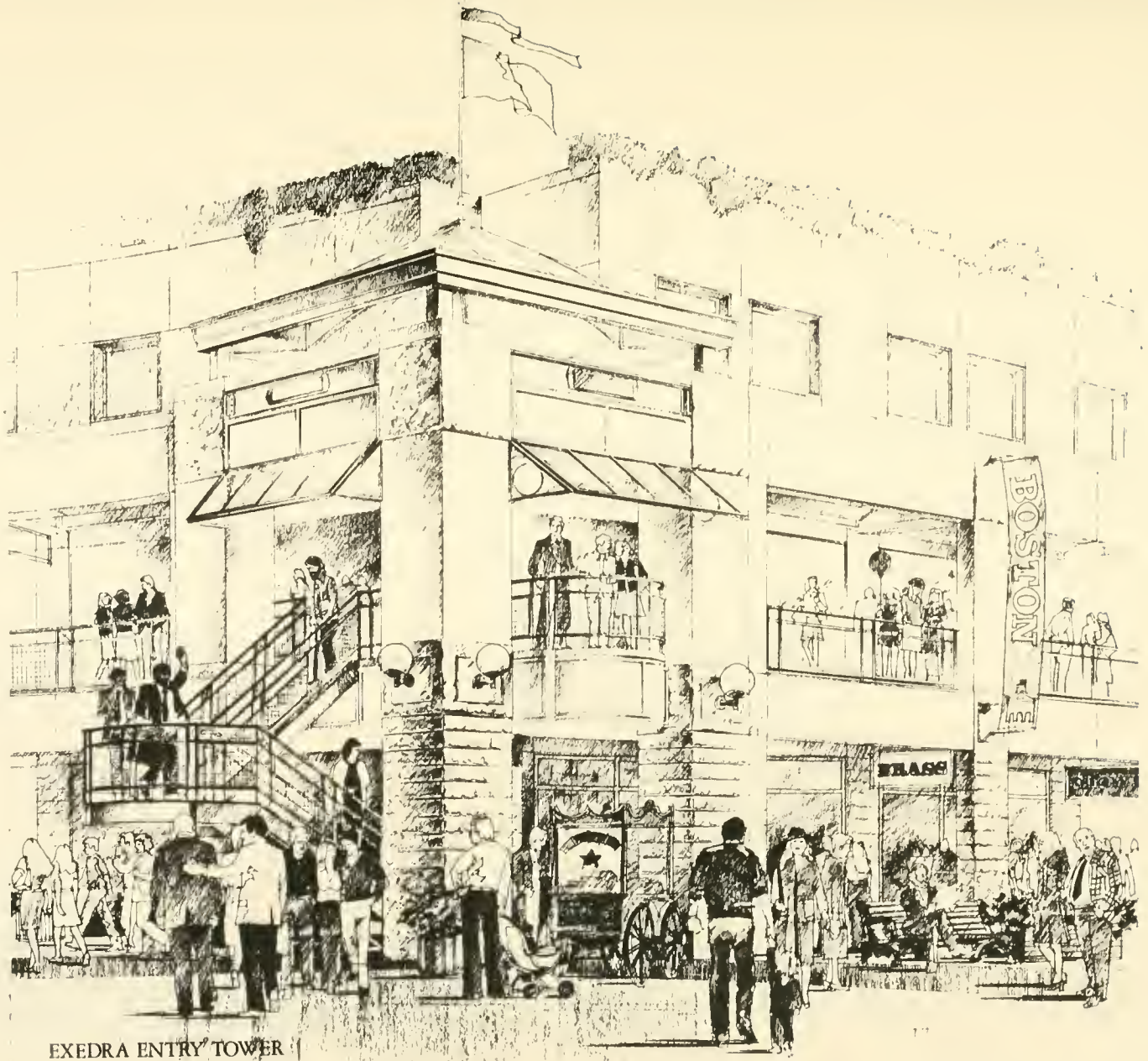
View from South Market Street looking Eastward



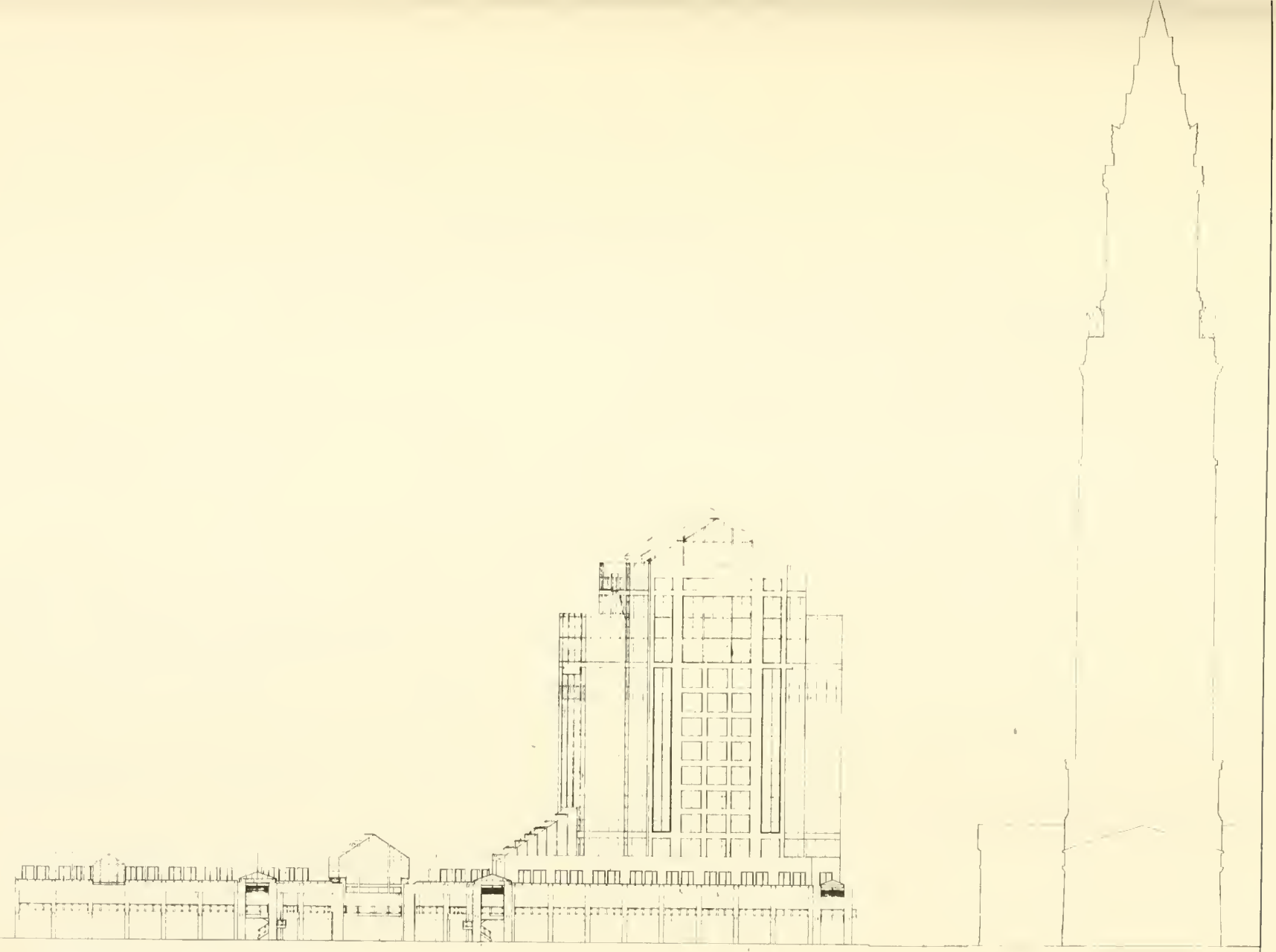
View from Beneath Central Artery Looking Westward



WALK-TO-THE-SEA CANOPY



EXEDRA ENTRY TOWER



COMMERCIAL STREET ELEVATION

Elevation Study Showing
Relationship to Custom
House Tower

URBAN DESIGN CHRONOLOGY

	Height	Office Floors	F.A.R.	Typical Office Floor	Approximate Gross Area
1. Original submission to B.R.A. and basis of E.N.F.	220 Ft.	16	5.8	25,000 Sq. Ft.	506,000 Sq. Ft.
2. Early design review-office element moved away from Commercial Street-- submission of Draft E.I.R.	284 Ft.	21	6.0	20,055 Sq. Ft.	543,000 Sq. Ft.
3. Continued design review-base moved out to State Street at request of Mass. Historical Comm. and Boston Landmarks Commission-submission of supplement to draft E.I.R.	284 Ft.	21	6+	20,055 Sq. Ft.	549,000 Sq. Ft.
4. Final B.R.A. design approval and submission of final E.I.R.	220 Ft.	16	5.25	20,055 Sq. Ft.	447,000 Sq. Ft.

Part I

Environmental Notification Form

APPENDIX A
COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

ENVIRONMENTAL NOTIFICATION FORM

Do not write in this space

I. SUMMARY

A. Project Identification

1. Project Name Marketplace Center

2. Project Proponent Marketplace Center Associates
   Address One Boston Place, Suite 1026
   Boston, MA

B. Project Description: (City/Town(s) Parcel D-10

1. Location within city/town or street address Commercial and State Streets, Boston, Massachusetts

2. Est. Commencement Date: Fall 1982 Est. Completion Date: Fall 1984
   Approx. Cost $ $60,000,000 Current Status of Project Design: 15 % Complete

C. Narrative Summary of Project

Describe project and give a description of the general project boundaries and the present use of the project area. (If necessary, use back of this page to complete summary).

The proposed project calls for the construction of an office building with first and second level retail space on an existing, under-utilized, city-owned property. An autmobile restriction will be placed on Commercial St. from State St. to Clinton St. The developer will be responsible for upgrading the Commercial St. right-of-way including any resurfacing, installation of street furniture, and landscaping. The design of the project and selection of construction materials are subject to approval by the BRA.

The portion of the property directly east of the Faneuil Hall Marketplace would be constructed in similar proportions to the Marketplace buildings and will be "arcaded" to assure continuity in the pedestrian easement, Walkway-to-the-Sea". In addition, the Walk-to-the-Sea will be extended under the Central Artery structure, thereby creating a cleaner, safer connection to the waterfront area. The first and second levels of this building will be dedicated to shops, restaurants, a museum and other appropriate public uses. To the south on the parcel, adjacent to State St., a 16 to 18 story office building will be erected. Like the low rise buiding, the office tower will have retail uses on the street floor. A sanitary sewage storage tank will be installed, if required, for the retention of site generated flows with subsequent discharge into the City of Boston sewage system at off-peak hours. Parking for approximately 240 cars will be provided within the building.

Copies of this may be obtained from:
Name: James F. Sullivan, Esq. Firm/Agency: Marketplace Center Associates
Address: One Boston Place Suite 1026 Boston, Mass. Phone No. 742-0012

THIS IS AN IMPORTANT NOTICE. COMMENT PERIOD IS LIMITED

Use This Page to Complete Narrative, if necessary.

32

The project site is a triangularly shaped property known as Parcel D-10. It is bounded by Commercial St. on the west, State St. on the south and the Under Artery on the east. Currently, the property is used for public parking (179 spaces). An additional 12 vehicles are parked outisde of the public parking area. It is crossed by the cobblestone (Walk-to-the-Sea) and the northern point of the triangular parcel is occupied by the maintenance building for the Faneuil Hall Marketplace. The uses provided by this facility will be incorporated into the project described here.

This project is one which is categorically included and therefore automatically requires preparation of an Environmental Impact Report : YES x NO _____

D. Scoping (Complete Sections II and III first, before completing this section.) (See Supplemental Information Sheet)

1. Check those areas which would be important to examine in the event that an EIR is required for this project. This information is important so that significant areas of concern can be identified as early as possible, in order to expedite analysis and review.

	Construction Impacts	Long Term Impacts		Construction Impacts	Long Term Impacts
Open Space & Recreation			Mineral Resources		
Historical			Energy Use		
Archaeological			Water Supply & Use		
Fisheries & Wildlife			Water Pollution		
Vegetation, Trees			Air Pollution	x	
Other Biological Systems			Noise	x	
Inland Wetlands			Traffic		
Coastal Wetlands or Beaches			Solid Waste		x
Flood Hazard Areas			Aesthetics		x
Chemicals, Hazardous Substances, High Risk Operations			Wind and Shadow		x
			Growth Impacts		
Geologically Unstable Areas			Community/Housing and the Built Environment		
Agricultural Land					
Other (Specify)					

2. List the alternatives which you would consider to be feasible in the event an EIR is required.

Alternatives which might be considered feasible by the developer include design modifications and program adjustments affecting the character of the street level uses.

31

E. Has this project been filed with EOEA before? Yes _____ No X
If Yes, EOEA No. _____ EOEA Action? _____

F. Does this project fall under the jurisdiction of NEPA? Yes _____ No X
If Yes, which Federal Agency? _____ NEPA Status? _____

G. List the State or Federal agencies from which permits will be sought:

Agency Name	Type of Permit
Boston Redevelopment Authority	Developer Designation and Long-Term Land Lease
Boston Public Works Department	Curb Cut Permit
Boston Zoning Board of Appeals	Variances

H. Will an Order of Conditions be required under the provisions of the Wetlands Protection Act (Chap. 131, Section 40)?
Yes _____ No X
DEQE File No., if applicable: _____

I. List the agencies from which the proponent will seek financial assistance for this project:

Agency Name	Funding Amount
None	

PROJECT DESCRIPTION

A. Include an original 8½ x 11 inch or larger section of the most recent U.S.G.S. 1:24,000 scale topographic map with the project area location and boundaries clearly shown. Include multiple maps if necessary for large projects. Include other maps, diagrams or aerial photos if the project cannot be clearly shown at U.S.G.S. scale. If available, attach a plan sketch of the proposed project.

B. State total area of project: 2.1± Acres
Estimate the number of acres (to the nearest 1/10 acre) directly affected that are currently:

1. Developed ..... 2.0± acres
2. Open Space/Woodlands/Recreation 0.1± acres
3. Wetlands ..... ___ acres
4. Floodplain ..... ___ acres
5. Coastal Area ..... ___ acres
6. Productive Resources
   - Agriculture ..... ___ acres
   - Forestry ..... ___ acres
   - Mineral Products ..... ___ acres

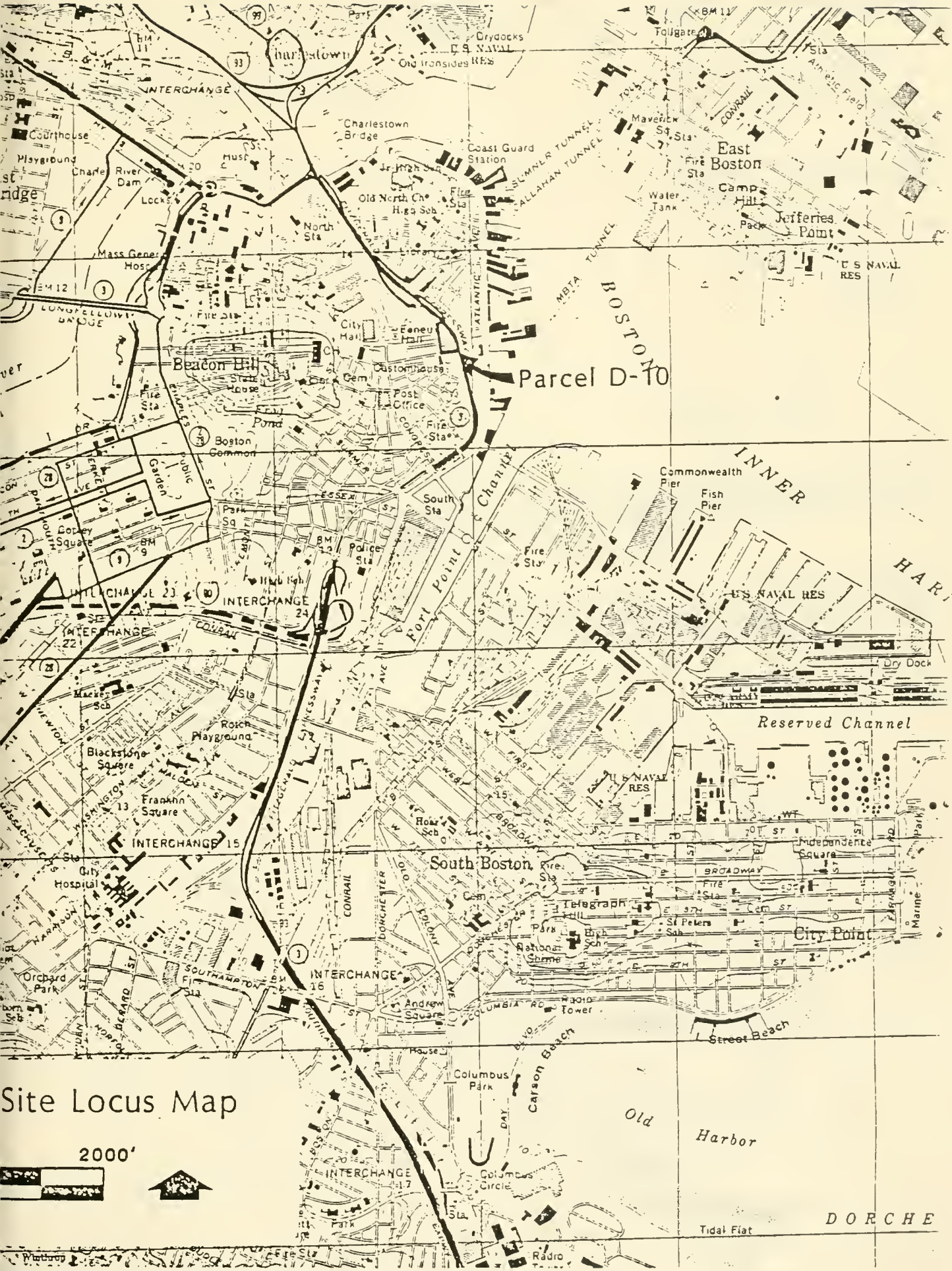
*See Supplemental Information Sheet

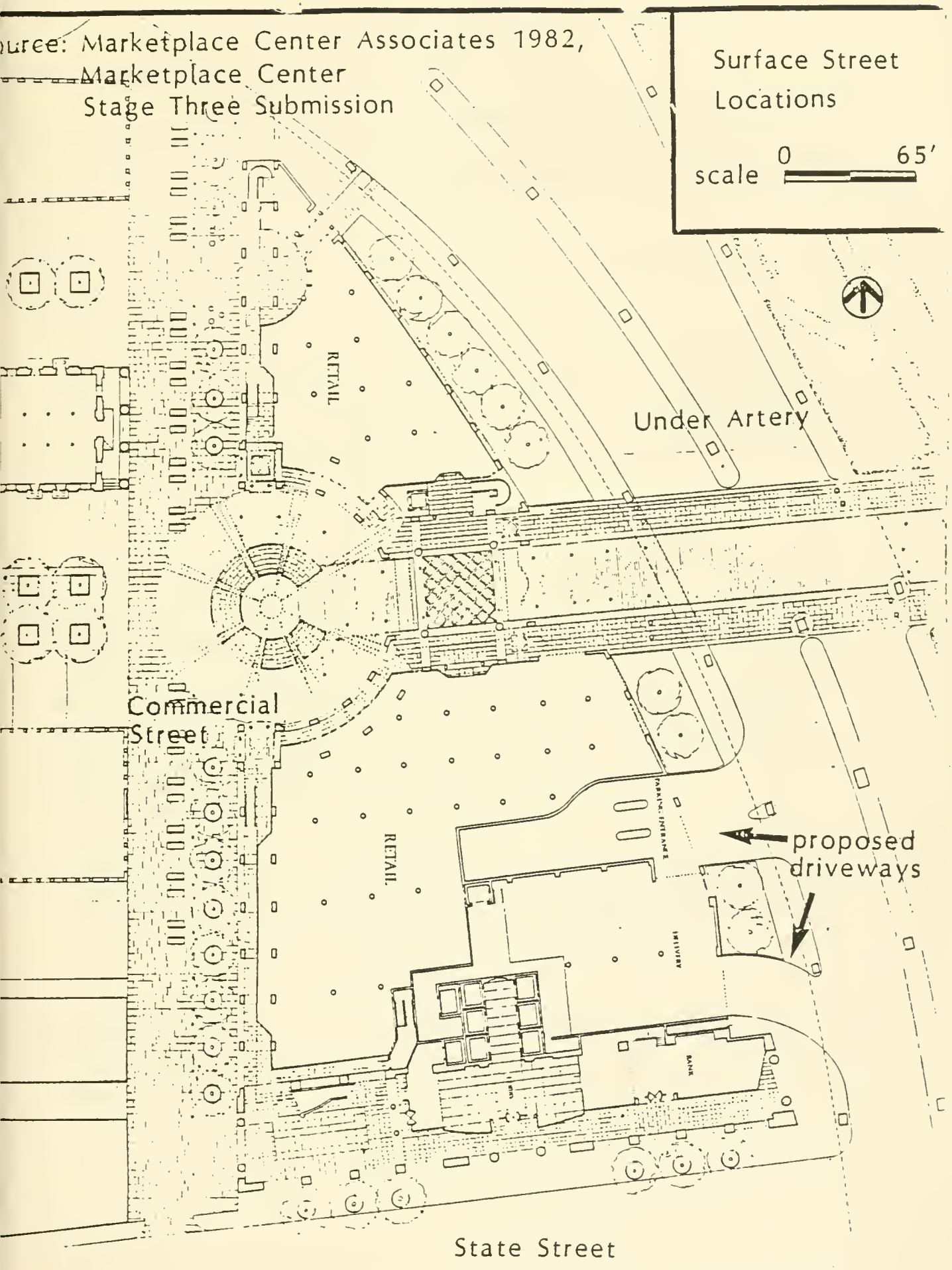
C. Provide the following dimensions, if applicable: (See Attachment A)
Length in miles _____ Number of Housing Units _____ Number of Stories 3-18

	Existing	Immediate Increase Due to Project
Number of Parking Spaces ..... approx.	179	61
Vehicle Trips to Project Site	700-900/day	0

Estimated Vehicle Trips past project site 25,000-35,000 AWDT 0

D. If the proposed project will require any permit for access to local or state highways, please attach a sketch showing the location of the proposed driveway(s) in relation to the highway and to the general development plan; identifying all local and state highways abutting the development ; and indicating the number of lanes, pavement width, median strips and adjacent driveways on each abutting highway. and indicating the distance to the nearest intersection.


Parcel D-10
Site Locus Map
2000'
Beacon Hill
South Boston
East Boston
Jeffries Point
City Point
Old Harbor
Reserved Channel
Fort Point Channel
INNER HARBOR
BOSTON
Charlestown
Boston Common
Public Garden
Copley Square
Back Bay
South Sta
North Sta
Commonwealth Pier
Fish Pier
Dry Dock
Carson Beach
Columbus Park
Andrew Square
Franklin Square
Blackstone Square
Roxbury Playground
Orchard Park
Tidal Flat
Old North Church
Bunker Hill Monument
Charlestown Bridge
Coast Guard Station
Mass General Hospital
City Hospital
Courthouse
Playground
Charles River Dam
Locks
Old Ironsides
Drydocks
U.S. NAVAL RES
Tollgate
Athletic Field
Maverick Sq
Fire Sta
Water Tank
Pier
City Hall
Faneuil Hall
Customhouse
Post Office
Police Sta
Gas
Gen
Cem
Ch
Sch
Tower
Tunnel
Sumner Tunnel
Callahan Tunnel
MBTA Tunnel
Atlantic Ave
Summer St
Essex St
Broadway
First St
Dorchester Ave
Old Colony
Conrail
Washington St
Columbia Rd
Day Blvd
Telegraph Hill
Independence Square
St Peters
Street Beach
Harrison Ave
Southampton St
Albany St
Melnea Cass Blvd
Mystic River
Charles River
INTERCHANGE 15
INTERCHANGE 16
INTERCHANGE 17
INTERCHANGE 22
INTERCHANGE 23
INTERCHANGE 24
BM 9
BM 10
BM 11
BM 12
Tidal Flat
Radio Tower


Source: Marketplace Center Associates 1982,
Marketplace Center
Stage Three Submission
Surface Street
Locations
scale 0 65'
Under Artery
RETAIL
Commercial
Street
RETAIL
proposed
driveways
DELIVERY
BANK
State Street

ASSESSMENT OF POTENTIAL ADVERSE ENVIRONMENTAL IMPACTS

Instructions: Consider direct and indirect adverse impacts, including those arising from general construction and operations. For every answer explain why significant adverse impact is considered likely or unlikely to result.

Also, state the source of information or other basis for the answers supplied. If the source of the information, in part or in full, is not listed in the ENF, the preparing officer will be assumed to be the source of the information. Such environmental information should be acquired at least in part by field inspection.

A. Open Space and Recreation

1. Might the project affect the condition, use or access to any open space and/or recreation area?
   Yes _x_ No _____

Explanation and Source:

The proposed project will include two low-level retail/office buildings on either side of the public pedestrian, "Walk-to-the Sea". A glass canopy will span the walkway between the buildings to maintain an open atmosphere and to provide upgraded lighting. This treatment will be continued from the site under the Central Artery, thus providing a safer pedestrian climate. This upgrading will facilitate pedestrian access to the Waterfront Park, Aquarium, and Waterfront in general.

B. Historic Resources

1. Might any site or structure of historic significance be affected by the project? Yes _____ No _x_

Explanation and Source:

There will be no direct effect on sites or structures of historic significance due to the implementation of the project. The site is, however, adjacent to the Faneuil Hall Marketplace which is listed on the National Register of Historic Places. Therefore, special attention will be given to the selection of building materials, colors, and textures in accordance to the design criteria established by the BRA.

2. Might any archaeological site be affected by the project? Yes _____ No _x_

Explanation and Source:

Archaeological artifacts are not of concern on the project site because of the prior disturbances to which the site has been subjected and the fact that the property is filled land (Sasaki Associates, Inc., 1978, DEIS Dock Square Parking Garage Parcel E-8, Dock Square Parking Associates).

C. Ecological Effects

1. Might the project significantly affect fisheries or wildlife, especially any rare or endangered species?
   Yes _____ No _x_

Explanation and Source: Site Inspection, Sasaki Associates, Inc., March 1982.

2. Might the project significantly affect vegetation, especially any rare or endangered species of plant?
Yes _____ No _x_
(Estimate approximate number of mature trees to be removed: _____)

Explanation and Source: Site Inpsection, Sasaki Associates, Inc., March 1982.

3. Might the project alter or affect flood hazard areas, inland or coastal wetlands (e.g., estuaries, marshes, sand dunes and beaches, ponds, streams, rivers, fish runs, or shellfish beds)? Yes _____ No _x_

Explanation and Source:

The site is not within a flood hazard area nor will the project alter any of these water resources. Site Inspection, Sasaki Associates, Inc., March 1982 and review of flood hazard maps.

4. Might the project affect shoreline erosion or accretion at the project site, downstream or in nearby coastal areas? Yes _____ No _x_

Explanation and Source:

The Parcel is presently paved and stormwater runs off into the street drainage system eventually to outfalls in Boston Harbor. The site is presently 100% impervious surface; therefore, the proposed project will not exacerbate further erosion or accretion.

5. Might the project involve other geologically unstable areas? Yes _____ No _x_

Explanation and Source:

Boring logs from the adjacent Parcel E-8 indicate groundwater is encountered at a depth of 7 to 18 feet below the surface. This groundwater system, although not significant as an aquifer or water supply, underlies the foundation of adjacent structures, particularly those in the historic Market District. Construction dewatering has the potential to cause sloughing and susidance of soils underlying the Markets. Such conditions could contribute to structural weakening of market area buildings (Sasaki Associates, Inc., 1978, DEIS, Dock Square Parking Garage, Parcel E-8). Proper foundation design and construction practices can eliminate any risk of sloughing or subsidance on the site or adjacent properties

D. Hazardous Substances

1. Might the project involve the use, transportation, storage, release, or disposal of potentially hazardous substances?
Yes _x_ No _____

Explanation and Source: There will be 240 garaged parking spaces; thus, a permit for storage of flammable materials (gasoline in parked vehicles) will be required.

E. Resource Conservation and Use

1. Might the project affect or eliminate land suitable for agricultural or forestry production?
Yes _____ No X
(Describe any present agricultural land use and farm units affected.)

Explanation and Source: Site Inspection, Sasaki Associates, Inc., March 1982.

2. Might the project directly affect the potential use or extraction of mineral or energy resources (e.g., oil, coal, sand & gravel, ores)? Yes _____ No X

Explanation and Source: Site Inspection, Sasaki Associates, Inc., March 1982.

3. Might the operation of the project result in any increased consumption of energy? Yes X No _____

Explanation and Source:
(If applicable, describe plans for conserving energy resources.) During construction, energy will be will consumed via equipment operationand vehicle travel to and from the site of the proposed project. Operation of air conditioners, heating units and lights will result in long-term direct energy consumption. Commutation to the building will result in long-term indirect energy consumption. To the extent that the project increases the use of public transportation, it will improve the energy efficiency of the system by increasing the passenger to energy unit ratio.

F. Water Quality and Quantity

1. Might the project result in significant changes in drainage patterns? Yes _____ No X

Explanation and Source:
Site Inspection, Sasaki Assocaites, Inc. March 1982.

2. Might the project result in the introduction of pollutants into any of the following:
(a) Marine Waters ..... Yes _____ No X
(b) Surface Fresh Water Body ..... Yes _____ No X
(c) Ground Water ..... Yes _____ No X

Explain types and quantities of pollutants.

3. Will the project generate sanitary sewage? Yes x No _____

If Yes, Quantity: 33,606 gallons per day

Disposal by: (a) Onsite septic systems ..... Yes _____ No _____

(b) Public sewerage systems ..... Yes x No _____

(c) Other means (describe) _____

Consideration is being given to equipping the building with water saving devices such as aerating nozzles, low water use toilets, and spring handle water faucets. (See Attachment B)

4. Might the project result in an increase in paved or impervious surface over an aquifer recognized as an important present or future source of water supply? Yes _____ No x

Explanation and Source:

Site Inpsection, Sasaki Associates, Inc., March 1982.

5. Is the project in the watershed of any surface water body used as a drinking water supply?

Yes _____ No x

Are there any public or private drinking water wells within a 1/2-mile radius of the proposed project?

Yes _____ No x

Explanation and Source: Site Inspection, Sasaki Associates, Inc., March 1982.

6. Might the operation of the project result in any increased consumption of water? Yes _____ No _____

Approximate consumption 33,606 gallons per day. Likely water source(s) _____

Explanation and Source: The water will be used for public and office restroom facilities, and general restaurant operations.

7. Does the project involve any dredging? Yes _____ No x

If Yes, indicate:

Quantity of material to be dredged _____

Quality of material to be dredged _____

Proposed method of dredging _____

Proposed disposal sites _____

Proposed season of year for dredging _____

Explanation and Source:

Site Inspection, Sasaki Associates, Inc., March 1982.

G. Air Quality

1. Might the project affect the air quality in the project area or the immediately adjacent area?
Yes _____ No X

Describe type and source of any pollution emission from the project site. There are 700 to 900 vehicle trips per day to the parking lot presently covering Parcel D-10 (BRA traffic survey 1980). The location of this parking facility contributes to traffic congestion in the vicinity of the Faneuil Hall Marketplace. Although the proposed project will attract nearly the same daily traffic volume (800 vehicle trips), the elimination of the surface parking and the addition of an automobile restriction on Commercial St. will relieve some of the local air quality degradation.

2. Are there any sensitive receptors (e.g., hospitals, schools, residential areas) which would be affected by any pollution emissions caused by the project, including construction dust? Yes _____ No X

Explanation and Source: The outdoor concessions and park benches in the Marketplace create an inviting atmosphere where individuals spend prolonged periods of time. Therefore, these areas may be considered sensitive receptors to air quality degradation. Due to their proximity to the proposed project, these areas could be subject to dust during construction. However, the use of dust palliatives during these activities will minimize the disturbances.

3. Will access to the project area be primarily by automobile? Yes _____ No X

Describe any special provisions now planned for pedestrian access, carpooling, buses and other mass transit.
The proposed project will provide 240 parking spaces; however, the removal of the existing parking lot will eliminate 179 parking spaces resulting in a net increase of 61 parking spaces. Due to the urban setting of the project and the lack of parking space in the vicinity, access will be primarily by public transportation. Additionally, pedestrian accessibility will be maintained by upgrading the public easement Walk-to-the-Sea. Public transportation provides easy access to the site with subway stations: Aquarium, Blue Line; Haymarket, Orange Line, and Government Center, Green Line; within 1/4 mi. walking distance.

H. Noise

1. Might the project result in the generation of noise? Yes X No _____

Explanation and Source:
(Include any source of noise during construction or operation, e.g., engine exhaust, pile driving, traffic.)
Construction activity will elevate the noise levels in the vicinity of the Marketplace, even though noise levels are already high due to heavy traffic volumes on the major access roads. Construction noise will be controlled so as to conform to City of Boston Ordinances.

After the project has been constructed, the presence of the buildings will act as a noise barrier to noise generated along the Central Artery and the Under Artery.

2. Are there any sensitive receptors (e.g., hospitals, schools, residential areas) which would be affected by any noise caused by the project? Yes X No _____

Explanation and Source: The outdoor concessions, cafes, benches, and promenades in the Faneuil Hall Marketplace are considered sensitive receptors to noise disturbances.

I. Solid Waste

1. Might the project generate solid waste? Yes _x_ No _____

Explanation and Source:
(Estimate types and approximate amounts of waste materials generated, e.g., industrial, domestic, hospital, sewage sludge, construction debris from demolished structures.)

The project will generate approximately 4,800 pounds of solid waste per day. The waste will be derived from restaurant, commercial building, and retail area general uses. A private contractor will be hired for the removal of solid waste (See Attachment C).

J. Aesthetics

1. Might the project cause a change in the visual character of the project area or its environs?
Yes _x_ No _____

Explanation and Source: The present view of the proposed project site from the Marketplace Plaza is characterized by an "island of automobiles" backdropped by the elevated structure of the Central Artery. The development of the site will be designed to change the present "dead space" into an aesthetically pleasing complement to Faneuil Hall Marketplace and State St. Customs House. This will be articulated through appropriate street level land uses and attention to the height, style, texture, and architecture of the proposed buildings.

2. Are there any proposed structures which might be considered incompatible with existing adjacent structures in the vicinity in terms of size, physical proportion and scale, or significant differences in land use?
Yes _____ No _x_

Explanation and Source: The southern portion of Parcel D-10 opposite Chatham Street will have a 16 to 18 story office tower, 220 to 244 feet in height. The tower will be constructed so as to complement buildings along the State Street block by lending special consideration to scale, texture and intended "street level" use. The upper stories of the tower will be "stepped" so as to minimize the tower massing, permit solar access and reduce shadow effects. The biggest expanse of the parcel will be developed to three story buildings similar in style and height to existing Faneuil Hall buildings.

3. Might the project impair visual access to waterfront or other scenic areas? Yes _____ No _x_

Explanation and Source: The Central Artery viaduct precludes a direct line of sight to the Waterfront Park and Boston inner-harbor from the Marketplace, either at street level or from the buildings themselves.

K. Wind and Shadow

1. Might the project cause wind and shadow impacts on adjacent properties? Yes _x_ No _____

Explanation and Source: Shadow studies are being developed by the Architect (WZMH Group, Inc.). A consultant will be contracted to perform wind studies of the proposed building. This information will be submitted as soon as available to supplement this document.

CONSISTENCY WITH PRESENT PLANNING

A. Describe any known conflicts or inconsistencies with current federal, state and local land use, transportation, open space, recreation and environmental plans and policies. Consult with local or regional planning authorities where appropriate. The project is in response to the request for Developers as advertized by the Boston Redevelopment Authority, the City's planning agency. Specific guidelines for development of Parcel D-10 of the Waterfront Urban Renewal project were outlined the the "developer's kit" and were adhered to by the developer. The designation of a developer by the BRA culminates a planning process for the area which began in the 1960's with the implementation of the Waterfront Urban Renewal Project.

FINDINGS AND CERTIFICATION

A. The notice of intent to file this form has been/will be published in the following newspaper(s) :

(Name) Boston Globe (Date) March 27 or 29, 1982

B. This form has been circulated to all agencies and persons as required by Appendix B.

March 26, 1982
Date

Signature of Responsible Officer or Project Proponent

James F. Sullivan, Esq.
Name (print or type)

Address One Boston Place-Suite 1026
Boston, MA 02114

Telephone Number 742-0112

March 26, 1982
Date

Signature of person preparing ENF (if different from above)

Lawrence D. Carr
Name (print or type)

Address c/o Sasaki Associates, Inc.
64 Pleasant St.
Watertown, MA 02172

Telephone Number 926-3300

SUPPLEMENTAL INFORMATION SHEET

Page 32, Section I., Summary C

Project which include buildings with gross floor space over 500,000 square feet automatically require the preparation of an Environmental Impact Report, under MEPA regulations. The gross floor space is anticipated to range between 505,000 to 580,000 square feet.

Page 33, Section II, Project Description B

The project area of 2.1± acres includes Parcel D-10 (1.6± acres) and the Commercial Street right-of-way (0.5± acres). Developed area includes the Commercial St. right-of-way from State St. to Clinton St. and most of Parcel D-10 which is currently used for a parking lot. Open space/Woodlands/Recreation Area refers to the pedestrian easement, Walk-to-the-Sea, from the eastern edge of Commercial St. to the western edge of the Under Artery.

ATTACHMENT A

1. Existing vehicles trips to the site

   700-900 inbound trips/day (Source: BRA 1980 surveys)

2. Vehicle trips past site

   25,000-30,000 AWDT Includes 7,000 State St.
   4,000 Commercial St.
   15,000 Under Artery

   Does not include 130,000 per day on Central Artery (Source: 1977 Central Artery O & D, MDPW).

3. Vehicle trips to site (post-development)

   Assumptions -

   a. 7.3 person arrivals/1000 s.f.

      7.3 x 377.4 = 2,755

   b. 66% employee trips = 1,820
      34% visitor trips = 9.35

   c. Modal split

	Auto	Transit	Walk
Employee	36%	54%	10%
Visitor	45%	40%	15%

Trips

	Auto	Transit	Walk
Employee	655	985	180
Visitor	420	375	140

   d. Occupancy factor

      Employee = 1.5 persons/car
      Visitor = 1.1 persons/car

   e. Vehicle trips (inbound)

      Employee = 655/1.5 = 440
      Visitor = 420/1.1 = 400
      840

      (Source: BRA North Station Interim EIR) Copley Place Transportation Impacts

SOURCES OF TRAFFIC INFORMATION

1. Wilbur Smith and Associates, An Access Oriented Parking Strategy for the Boston Metropolitan Area, prepared for the Massachusetts Department of Public Works, July 1972.

2. Institute of Traffic Engineers, Trip Generation, 1976.

3. Parsons, Brinckerhoff, Quade & Douglass, Inc., and Norman A. Abend, Copley Place Transportation Impacts Study, February 8, 1980.

4. Cambridge Systematics, Inc. Transportation Impacts of the Park Plaza Urban Renewal Project, prepared for the Boston Redevelopment Authority, July 1975.

5. Tippetts-Abbett-McCarthy-Stratton, Boston Central Artery 1977 Origin - Destination Study, prepared for Massachusetts Executive Office of Transportation and Construction and Department of Public Works, Boston, November 1978.

6. National Academy of Sciences, Highway Research Board, Highway Capacity Manual, 1965.

7. Boston Redevelopment Authority, North Station Urban Renewal Project, Interim Environmental Impact Report, 1980.

ATTACHMENT B

Estimation of Sewage Generation

- Assume one 12,000 GSF restaurant with a 300-seat capacity (40 gross square feet/chair)

  Flowage at 35 gallons per day/seat = 10,500 gal/day

- Retail, Bank & Museum - same as dry goods store - 5 gal/day/100 GSF

  Net useable area

Retail	38,394	(includes restaurant)
Bank	3,200	
Museum	5,000	
	46,594	
	- 12,000	restaurant
	34,594	s.f. ÷ 100 x 5 gal/day = 1,730 gal/day

- Office building - 75 gal/day/1,000 GSF

  Net useable area

  285,009 ÷ 1,000 x 75 = 21,376 gal/day

Total = 33,606 gallons/day

The installation of water saving devices (i.e., aerating nozzles, low-water use toilets, spring handle faucets, etc.) by the developer, would result in a 20% efficiency factor. This would result in the following savings in water consumption.

33,606 gallons/day x .80 = 26,885 gallons/day

(From Title V of Mass. Environmental Code).

ATTACHMENT C

SOLID WASTE PRODUCTION

- Restaurant of 300 seats at 2.5 turnover per seat per day; each meal generates 2 lbs.

  300 seats at 2.5 meals/seat x 2 lbs./meal = 1,500 lbs./day

- Commercial building, office at 10 lbs./1,000 $ft.^2$ at net useable area of 285,009 $ft.^2$ ÷ 1,000 $ft.^2$ x 10 lbs. = 2,850 lbs./day

- Retail and service facility generates 13.0 lbs./1,000 $ft.^2$ assume net useable area of

retail	38,394 $ft.^2$	
bank	3,200 $ft.^2$	
museum	5,000 $ft.^2$	
=	46,594 $ft.^2$	
-	12,000 $ft.^2$	(restaurant)
	34,594 $ft.^2$	

34,594 $ft.^2$ ÷ 1,000 $ft.^2$ x 13 lbs. = 450 lbs./day

The proposed project will generate approximately 4,800 lbs./day of solid waste

Source: Salvato, J.A., Jr., 1972 Environmental Engineering and Sanitation 2nd Ed., Wiley-Interscience, NY

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EDWARD J KING
GOVERNOR
JOHN A BEWICK
SECRETARY

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS

ON

ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME:	Marketplace Center
PROJECT LOCATION:	Boston
EOEA NUMBER:	4389
PROJECT PROPONENT:	Marketplace Center Associates
DATE NOTICED IN MONITOR:	April 13, 1982

Pursuant to M.G.L., Chapter 30, Section 62A and Sections 10.04(1) and 10.04(9) of the Regulations Governing the Implementation of the Massachusetts Environmental Policy Act, I hereby determine that the above referenced project does require the preparation of an Environmental Impact Report. The scope and alternatives for the EIR shall be as follows:

The EIR should follow the format outlined in 301 CMR 10.05(7)(a) through (e) and (h). In place of sections (f) and (g) the EIR should address the impacts enumerated herein, and should contain a copy of this scope; comments received on the ENF; identification of permits required for the project; and the distribution of the EIR.

PROJECT IMPACTS

Traffic and Pedestrian Circulation

A. Traffic

1. The traffic study area shall comprise Under Artery Road in the vicinity of the project, State Street, Commercial Street, Chatham Street, Clinton Street and the signalized intersection at North and Blackstone Streets. Express the traffic results in volume/capacity ratio form.

2. The purpose of the analysis is to determine the impact of the project on traffic on surrounding streets. To accomplish this, the EIR should present daily traffic volumes (ADT) and a.m. and p.m. peak hour volumes for the streets within the study area for
   a. existing conditions
   b. design year no build conditions
   c. design year build conditions.

If the afternoon peak period is of longer duration than one hour, establish reasonable parameters to define its limits.

3. Identify congestion points for conditions a, b and c. What are the implications of the project with respect to the identified congestion points?

4. Show on a plan the proposed vehicular access to the site and the location of columns which support the Central Artery along the site. Evaluate the proposed access/egress on Under Artery Road with respect to its visibility to approaching vehicles, adequacy of sight distance for vehicles exiting the garage and loading area, taking into consideration potential obstruction of view caused by the columns, and impact on traffic flow on Under Artery Road. Evaluate alternative access locations on State Street and Commercial Street.

5. Identify on a plan the areas where traffic restrictions are proposed and describe the proposed use of the restricted areas. Evaluate the impact of the restricted designation on traffic on adjacent streets and on delivery and service operations to the existing market buildings. If changes in existing service and delivery routes are proposed, evaluate routing alternatives.

6. Describe plans to alter traffic signals and the median break on Under Artery Road.

7. Specify setback distances from the Central Artery for the proposed buildings, based on consultation with the Massachusetts Department of Public Works.

B. Pedestrian Circulation

1. Illustrate on a plan pedestrian routes and other outdoor areas open to pedestrians (including rooftops) on the site itself and on public ways adjacent to the site. Characterize the proposed design, landscaping and use of pedestrian and open space areas, including a discussion of lighting proposed along Under Artery Road and beneath the Central Artery.

2. Describe in the text and on a plan provision for continuous pedestrian access between Quincy Market and the Waterfront.

C. Propose measures to minimize traffic congestion and to enhance safe and equitable pedestrian passage.

Parking

1. Describe parking plans in terms of number of spaces, location and designated use, including provision of spaces for handicapped persons.

2. How will the use of spaces for their designated purpose (i.e. employees, customers and visitors of commercial establishments on the site) be implemented and enforced?

3. Explain how the plans relate to the City of Boston's parking freeze and identify aspects of the plans which require a City permit.

4. Evaluate the sufficiency of parking spaces to serve the proposed development.

5. Describe on-street parking policy.

6. Propose measures to help ensure the adequacy of the proposed parking facility and the operation of its use as intended. Recommend steps to alleviate obstructions to the view of approaching traffic for motorists exiting the parking garage.

7. Evaluate alternate access locations, considering visibility of and sight distance for exiting vehicles.

Air Quality

1. Evaluate the effects of the proposed access on carbon monoxide levels in the vicinity of the parking garage and delivery area. The analysis should compare 1-hour and 8-hour CO levels for existing, design year build and design year no build conditions. The evaluation should include a queuing analysis of traffic exiting the garage.

2. Examine the air quality impacts of an alternative access location on State Street and on Commercial Street.

3. Where CO violations occur, propose mitigating measures.

4. Analyze the impact of emissions from the garage ventilation stack and other mechanical equipment on sensitive receptors on and adjacent to the site.

Wind and Shadow Impacts

1. Identify the area which will be impacted by wind and shadow from the project.

2. Indicate on a plan the locations of open space and pedestrian passages (including entrances, streets, walkways, roof-level activity areas and outdoor concessions) within the study area.

3. After completing the analysis required by A and B below, assess the combined microclimactic impacts (wind, shadow, temperature) on public enjoyment of pedestrian areas in the study area.

A. Pedestrian Level Wind Study

1. Describe the study methodology and any assumptions and statistical data inherent in the analysis.

2. Taking into consideration other developments underway which might affect the study area, compare existing (no build) and post-development conditions in order to determine the incremental wind effects of the project. This analysis should examine wind velocities, the frequency and seasonal distribution of their occurrence and their probable effects on pedestrian comfort at identified receptor locations within the study area. The effects on physical force on people engaged in outdoor activities, the unpleasantness created by particulates and debris stirred by high winds, and all wind effects - no matter how small - on the users of Quincy Market should be addressed.

3. Examine the potential for gusts, or sudden variations in wind speed, and their impact on pedestrians.

4. Evaluate the potential for downdraft along the proposed high-rise building and, if warranted, suggest design modifications to minimize downdraft.

5. Identify locations where measures to minimize wind impact will be needed, propose appropriate remedial measures and describe the results they can be expected to achieve.

B. Stress Analysis

Evaluate the impacts of the physical force of wind exerted on the project buildings and on other nearby buildings.

C. Shadow Impact

1. Compare existing (no build) and post-development (build) shadow conditions in four seasons at the hours of 10:00 a.m., 12:00 noon, 2:00 p.m. and 4:00 p.m.

2. Evaluate the incremental shadow impacts of the project on the previously identified pedestrian areas and, if necessary, propose measures to minimize those impacts.

Visual Impact

1. Illustrate, by means of sketches and/or photographs of existing and proposed conditions, the impact of the project from all vantage points from which it will affect views of the nearby National Register buildings: the Customs House, the three existing market buildings, Faneuil Hall and the State Street Block Building. Indicate the corridors which will afford views of the historic buildings after development.

2. Show, by means of photos and/or sketches, the project's impact on views from the Central Artery and from the walk to the sea east of the Central Artery.

3. Evaluate the compatibility of the project's design with existing historic buildings.

4. What features of the portion of the walk to the sea within the project area will accentuate its tie-in to the existing walkways and serve as an inducement to continue along the designated way?

5. Evaluate alternative surface materials for the walkway. The cobblestone surface on the existing walkway, albeit attractive, makes passage difficult for wheelchairs, baby carriages and persons wearing high-heeled shoes.

Archeology

An archeological survey of the site, conducted in cooperation with the Massachusetts Hisotrical Commission, is underway. A description of the survey, its results and the recommendations of the MHC should be reported in the EIR.

Utilities and Services

Provide a plan in the EIR showing the location of existing utilities on or under the site, including solid waste disposal facilities, mechanical equipment serving the existing market buildings, electrical transformer vault, steam transmission line, gas line, telephone cables, water main and storm drainage facilities. State whether each utility will be relocated (and if so, show where) or incorporated into the project in its present location. Indicate how access to the utilities will be provided.

Sewage Disposal

Due to the frequent surcharged condition of sewers in the vicinity, plans should include a holding tank to regulate the timing of release of sewage. The tank should be sized to prevent intrusion of floodwater and seepage of sewage during storms up to and including a one hundred year event. Its specifications should satisfy requirements of the Massachusetts Division of Water Pollution Control and the Boston Water and Sewer Commission.

Water Consumption

Describe proposed water conservation techniques and evaluate their effects on water consumption.

Energy Use

1. Evaluate alternative heating and cooling systems in terms of fuel consumption. Evaluate the feasibility of using solar energy on site.

2. Propose measures to conserve energy, such as partial use of operable windows, heating zones, use of mechanical systems with the capability of using outside air to cool the buildings and any other measures the proponent wishes to suggest.

Construction Impacts

1. Outline the proposed construction schedule.

2. Care must be taken during construction dewatering to avoid alteration of the groundwater level and subsidence of soils underlying existing structures. Describe how dewatering can be accomplished without adversely effecting the structural support of existing buildings and the nearby MBTA Blue Line Tunnel. Suggest measures to minimize sediment loading and turbidity entering storm drains or sewage systems during dewatering activities.

3. Discuss potential effects of vibrations from pile driving on existing buildings and on the Blue Line Tunnel. The proponent should submit plans depicting the proposed foundations in relation to the Blue Line Tunnel to the MBTA for their review and should include the MBTA's recommendations in the EIR.

4. Describe the impacts of construction on the existing utility infrastructure, citing any special precautions which may be warranted?

5. Evaluate the impact of construction traffic within the traffic study area on noise, air quality and congestion. Propose truck routes which minimize these impacts and the degree of pedestrian exposure to construction traffic.

6. Describe plans for storage of construction vehicles, equipment and materials and for removal of consturction waste from the site.

7. Because of the site's proximity to an active pedestrian area, the importance of strict control of noise and air pollution during construction cannot be over emphasized. Compliance with the City of Boston regulations to control air and noise pollution is essential; but in this case everything which can be done should be done to ensure that activities in Quincy Market's outdoor areas are not temporarily spoiled or disrupted. The EIR should describe the relevant City regulations. It should identify the specific construction activities which will generate significant noise and dust and propose measures to alleviate those impacts. With respect to pile driving, the EIR should evaluate alternative noise reducing techniques, including sonic pile driving equipment, enclosing the equipment and preaugering.

8. Summarize proposed measures to minimize adverse impacts for all aspects of the construction process. In addition to those noted in the foregoing paragraphs, the EIR should consider scheduling of disruptive activities to avoid peak pedestrian periods; scheduling of deliveries to avoid peak traffic periods; protection and accommodation of pedestrians; designation of an individual at the construction site to respond to questions, address problems and ensure that mitigating measures are implemented as necessary.

Circulation of Draft and Final EIR

The proponent should distribute the Draft and Final EIR to all state and city permitting agencies, all public utility companies whose interests are involved and all persons who participated in the scoping process.

- - - - - - - - -

5/12/82
DATE

Samuel C. Myrth for
JOHN A. BEWICK, SECRETARY

Part II

Summary Sheet

Part II - Summary Sheet

1. The proposed project, entitled Marketplace Center, includes construction of a mixed-use building (446,860 GSF) and improved pedestrian access ways on a 2.1± acre parcel (Parcel D-10) located just east of the Faneuil Hall Marketplace and adjacent to the Central Artery viaduct in Boston, Massachusetts. The site which is owned by the Boston Redevelopment Authority (BRA), is bordered by Commercial Street, the Under Artery, and State Street (Figure 1). The building is designed in two massings: a three-story low-rise portion immediately east of the Faneuil Hall Marketplace and a 16-story office building adjacent to State Street. The lower floors will be occupied by retail shops, restaurants, and a museum. Parking for approximately 120 automobiles will be provided within the basement of the building. All parking will be assigned to building tenants.

   The designation of a developer for Marketplace Center (Parcel D-10) followed a competitive solicitation from the Boston Redevelopment Authority (BRA). To win this development competition, the developer adhered to the detailed guidelines established by the BRA and introduced concepts such as land leasing by the City and off-site improvements to the Walk-to-the-Sea.

   The Marketplace Center building is an element of Boston's Waterfront Urban Renewal Project. As such, it is consistent with the goals of the BRA and its architectural and aesthetic compatibility with adjacent historic districts and nearby waterfront park is assured by virtue of the on-going project review process established with the developer and architect by the BRA.

2. EOEA file number: 4389

3. Marketplace Center Associates
   189 State Street, 8th Floor
   Boston, Massachusetts 02109

4. This document is a Final Environmental Impact Report.

5. The proposed project site is located just east of the Faneuil Hall Marketplace and west of the Central Artery viaduct in the City of Boston, Suffolk County, Massachusetts. Essential services (i.e., water, sewer, and fire and police protection) will be provided by the City of Boston. Trash will be collected by a private contractor.

6. The project will transform an underutilized parcel into an attractive commercial and cultural space that will also create a long-term revenue source for the City of Boston. The total cost of construction is estimated at $37,000,000. Major environmental impacts due to the proposed mixed-use building will include the following:

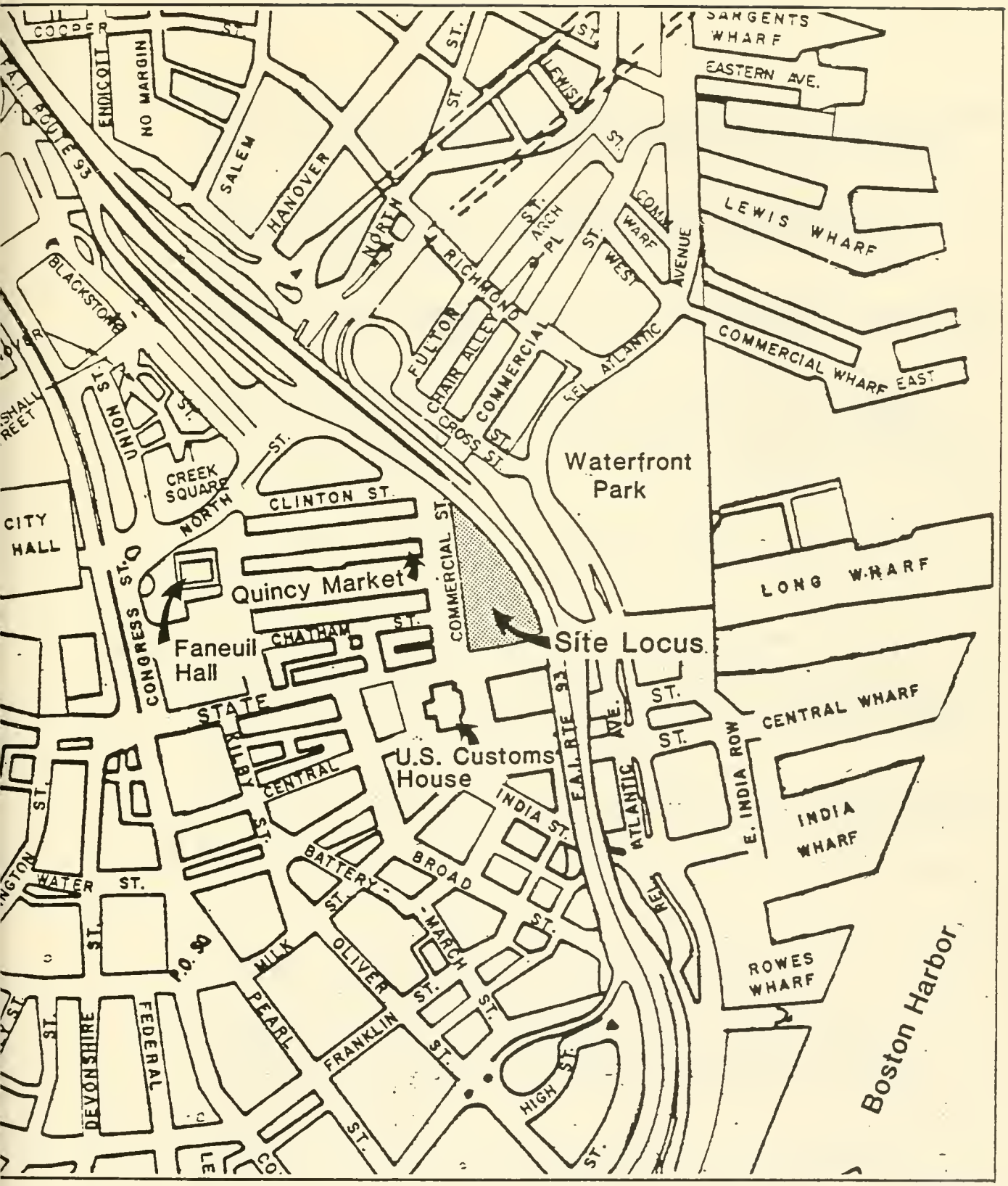


Figure 1
Site Locus Map

Sasaki Associates, Inc.

Marketplace Center
Boston, Massachusetts

- The presence of the building will create some shadow effects along the eastern edge of the Faneuil Hall Marketplace most noticeable during spring and summer morning hours.

- Design and construction materials will be closely supervised by the BRA to ensure the finished product retains the same visual character as the surrounding historic district.

- Abandoned underground public utilities will be removed and active systems will be relocated or installed.

- An automobile restriction will be imposed on a segment of Commercial Street. The street will be open to general traffic to Chatham Street; from Chatham Street north, it will remain open to service vehicles. Other than changes to Commercial Street, there are no anticipated impacts on the transportation network.

- There are no unhealthy air quality conditions expected from any alteration of traffic circulation due to the project.

- Any increase of noise from building equipment will be controlled by standard engineering practices. The building will create a positive side effect by acting as a noise barrier to traffic on the Central and Under Artery thereby decreasing ambient noise levels along the eastern edge of the Faneuil Hall Marketplace.

- The most cost efficient energy system has been designed for the project, and it is detailed in part VI of this report.

- Studies on wind and archaeological impacts are included in this report.

- There are no anticipated geological impacts which can not be addressed by standard engineering practices.

- Construction activities are likely to create major disturbances and all reasonable mitigation measures will be employed to ensure the continued enjoyment of the historic, recreational, and retail districts adjacent to Marketplace Center.

- Marketplace Center will alter the visual character of major vistas of historic buildings in the area. Judgments as to visual impact are subjective at best, however, the project will supplant an existing parking lot which is visually incompatible with the area. Major pedestrian improvements including a significant upgrading of the Walk-to-the-Sea will be among the major public benefits of this project.

Part III

Description of the Project

Part III - Description of the Project

1. The developer proposes to construct a 446,860GSF mixed-use building (retail, museum, and office) adjacent to the Faneuil Hall Marketplace in Boston, Massachusetts.

2. The objective of the project is to transform a presently underutilized parcel within Boston's Waterfront Urban Renewal Project Area into productive and attractive commercial and cultural space.

The project will enhance the pedestrian environment of the Faneuil Hall Marketplace and add retail, restaurant, and office space to an area where demand for such establishments is high. The project also will improve the visual and noise environment of the Faneuil Hall Marketplace by eliminating the existing open parking lot, partially screening the unsightly and noisy Central Artery, and highlighting the entrance to the Walk-to-the-Sea.

The proposed design includes several public amenities: improvements to the Walk-to-the-Sea, pedestrian improvements to Commercial Street, the Museum of Boston, and street-level shops. As a result of the project, the Walk-to-the-Sea will be widened, paved with suitable material, and illuminated beneath the Fitzgerald Highway viaduct. In addition to these safety and aesthetic improvements, a glass canopy will span the walkway as it passes through the building. This canopy, to be flanked by glazed arcades, will present a visually wider and more enticing entrance to the Walk-to-the-Sea.

An automobile restriction will be adopted for Commercial Street. The resulting plaza will be paved, landscaped, and illuminated in the style of the Faneuil Hall Marketplace, thereby visually linking the Marketplace Center building with the existing Faneuil Hall Marketplace.

The proposed museum will provide an opportunity for the display of historic artifacts, particularly related to the waterfront and market district.

3. Except for the 16 story office building at the south portion of the building, the structure will be three stories in height. The 446,860 GSF floor area of the multi-use building will be apportioned as follows:

- Office space - 283,392 GSF
- Retail space (includes Bank and restaurants) - 69,456 GSF
- Museum space - 5,000 GSF
- Parking - 43,230 GSF
- Miscellaneous (Includes maintenance space, corridors, arcade, Etc.) - 42,763 GSF

Additional facilities will include garage parking for approximately 120 cars and a trash collection center. Construction of a cooperative trash collection facility, to be located within Marketplace Center, has been negotiated with the management of Faneuil Hall Marketplace. This facility will be operated by a private contractor.

Project plans call for significant safety and aesthetic improvements to the pedestrian Walk-to-the-Sea and imposition of an automobile restriction on Commercial Street (Figure 2). The cost of construction is estimated to be $37,000,000.

4. It is anticipated that the project will be completed within two years from commencement of construction. Construction is expected to begin in June, 1983.

5. Marketplace Center will be constructed using conventional building techniques. Since the bottom of the excavation will be at elevation 6 feet Boston City Datum (approximately the level of ground water), extensive de-watering will not be required. Only localized de-watering at the pile cap excavations will occur, if necessary. This minor de-watering will not affect adjacent structures. Excavation side walls will be vertical and shored with a soldier pile and wooden lagging system.

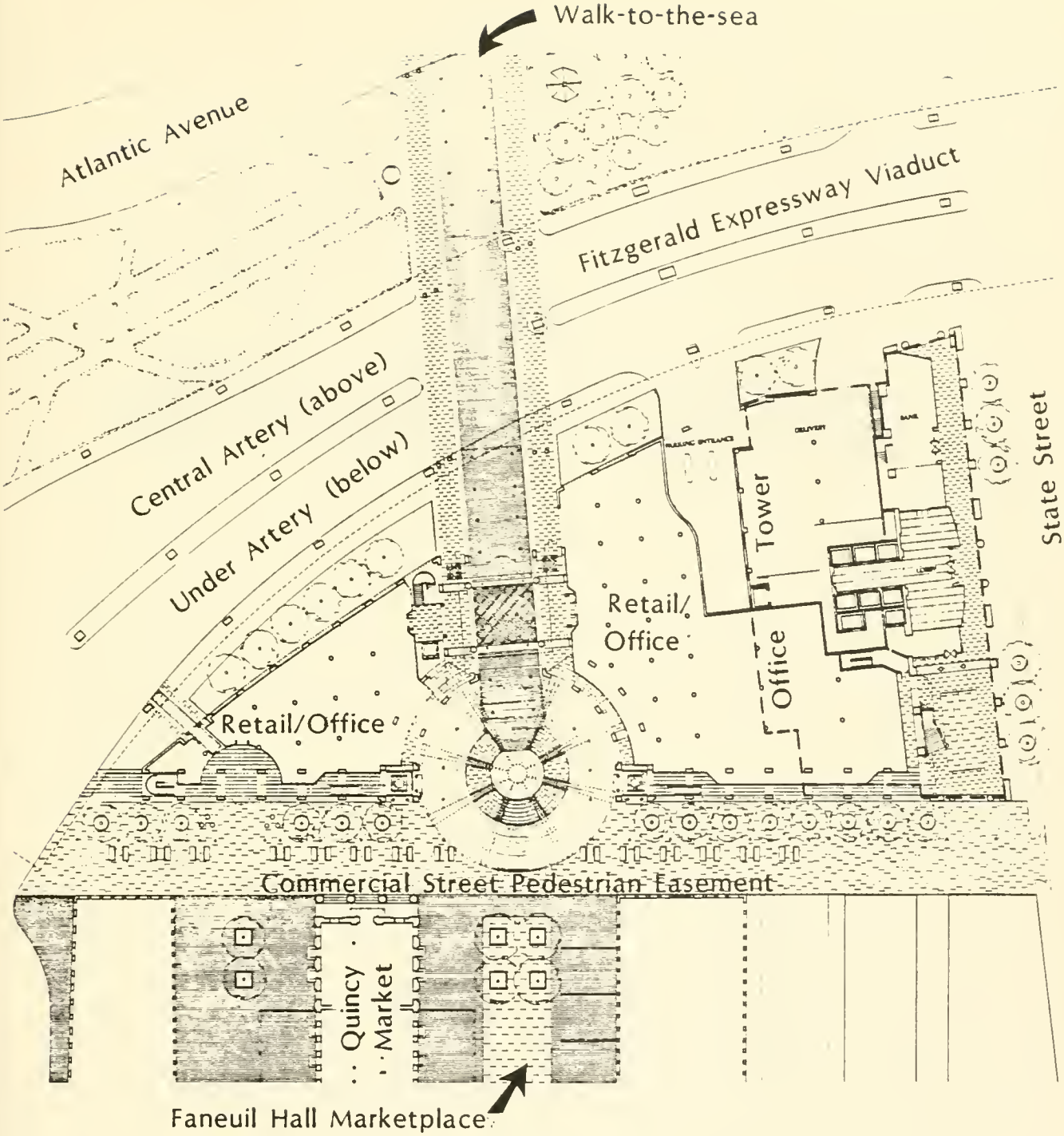


Figure 2

Plan of Proposed
Marketplace Center

Sasaki Associates, Inc.

Marketplace Center

Boston, Massachusetts

Part IV

Description of the Environment of the Area Likely to be Affected by the Proposed Project

Part IV Description of the Environment of the Area Likely to be Affected by the Proposed Project

1. Surrounding Area

The proposed Marketplace Center will be located in Boston's market district between the Waterfront Park and the Faneuil Hall Marketplace. With the exception of the Central Artery, which passes between the proposed site and the Waterfront Park, the surrounding area is a blend of retail/commercial and recreational land uses designed as a pedestrian environment.

Since the completion of renovations, the Faneuil Hall Marketplace has become a model of successful urban revitalization. Drawing millions of visitors each year, it has become one of the most renowned and popular marketplaces in the United States.

Boston's Waterfront Park, located just east of the proposed site, is a major attraction in the area. The Park provides visitors with a panoramic view of Boston Harbor and passive recreation opportunities.

Additional features of the proposed site's immediate surroundings include historic structures (Federal Customs House, the Quincy Market buildings, the Old State House, State Street Block, and Faneuil Hall), the close-by Government Center buildings, indoor parking facilities, and public transit stations.

2. Wind

Prevailing winds are westerly, being northwesterly in winter and southwesterly in summer. Wind speeds are greatest in January (averaging 14.2 MPH) and lowest in July and August (averaging 10.8 MPH). The yearly average is 12.6 MPH.

3. Topography, Geology, and Soils

The site essentially is a flat parking lot at elevation +16.0 feet (Boston City Base).

A soil borings program conducted by Haley and Aldrich, Inc. in 1982 indicated that the general geologic profile of the site is as follows:

Total Depth	Range in Thickness	Description of Material
15 ft.	15 ft.	Miscellaneous Fill
20-30 ft.	5-15 ft.	Organic Silt
70-80 ft.	50 ft.	Boston Blue Clay
75-90 ft.	5-10 ft.	Glacial Till
+75-+90 ft.	-	Cambridge Argillite (bedrock)

The maximum ground-water elevation is +5.0 to +8.0 feet (Boston City Base).

4. Land Use

The site is used as a parking lot which is licensed for a total of 179 vehicles. The northern corner of the parcel is occupied by the Faneuil Hall Marketplace maintenance building, and the Walk-to-the-Sea passes through the parcel in an east-west direction. The parking lot is paved with asphalt, and the Walk-to-the-Sea is paved with cobblestones.

5. Archaeology and Historic Land Use

The proposed site is a former landfill, and is therefore, disturbed land. However since the parcel was part of Boston's early waterfront, Marketplace Center funded an Archaeological "Dig" on the site, which took place in late summer of 1982. The work, conducted by the museum of Afro-American History, under contract to the Massachusetts Historical Commission is detailed in a report included as an appendix to this Environmentsal Impact Report.

Marketplace Center Associates has invited the Massachusetts Historical Commission to monitor material removed from the site during the actual excavation, and it has been agreed that artifacts together with descriptive material will be displayed in the "Museum of Boston" which will occupy some 5000 square feet of space in the retail area adjacent to the "Walk-to-the-Sea".

6. Utilities

Within the site of the proposed construction are storm drains, sewer lines, underground electric and telephone conduits, water mains, a 16-inch diameter steam main, and a 30-inch diameter, intermediate pressure gas main.

7. Traffic

7.1 Street and Highway Network

A number of the region's major highways provide access to the immediate vicinity of the Marketplace Center project. Interstate Route 93 passes immediately adjacent to the site via the Boston Central Artery. Access from the north and west via Storrow Drive occurs at North Street, one block from the project. Access to south and west via the Massachusetts Turnpike occurs several blocks to the south via the Purchase Street and Northern Avenue Ramps. The Sumner/Callahan Tunnels provide direct access to Logan International Airport as well as the northeast suburbs. They are located just north of the project site and are

accessible via the Under Artery roadway.

The principal local streets serving the Marketplace Center area are State Street, Commercial Street and the John F. Fitzgerald Surface Road (Under Artery roadway). State Street is a one-way westbound roadway connecting Atlantic Avenue east of the project site to Congress Street, Washington Street and Cambridge/Tremont Streets via Court Street. The Under Artery is the primary north-south street in the vicinity of the project. It is a six lane divided roadway immediately beneath the Central Artery viaduct. South of State Street it is paralleled by Atlantic Avenue, another major six lane street. Access to the Southeast Expressway and Massachusetts Turnpike is primarily via either Atlantic Avenue or the Surface Road. Commercial Street is a one-way northbound street which primarily serves abutting properties. One of its major uses is to provide truck access to the Quincy Market Development. The existing street system and highway network is shown on Figure I.

Traffic volumes on major project area streets for the P.M. peak hour and the peak 8 hours are included in Appendix I.

Levels of service at the major intersections within the project vicinity are indicated in Table 1 and range from A to E for various peak hours.

Table 1
Existing Level of Service (Volume/Capacity Ratios)

	AM Peak Hour 8:00 - 9:00	P.M. Peak Hour 4:30 - 5:30
State St./Under Artery	A (.568)	B (.683)
Clinton St./Commercial St./ Under Artery	A (.604)	D (.811)
Blackstone St./North St/ Off Ramp	E (.916)	E (.978)

7.2 Public Transportation System

The Marketplace Center project site is within short walking distance of several rapid transit lines, commuter bus lines and commuter ferry terminals.

The MBTA Blue Line stops at Aquarium Station (400 feet walking distance) and State Street Station (1000 feet walking distance). The Orange Line stops at State Street and Haymarket Square (1500 feet), and the Green Line has stops at Haymarket Square and Government Center (1600 feet). Several North Shore commuter bus lines stop at

Haymarket Square and commuter boat service from the South Shore is available at Long and Rowe's Wharfs.

7.3 Parking Facilities

Within a five minute walk to the Marketplace Center project area there currently exists a total of 2,801 off-street parking spaces which are open to the public. This is exclusive of the existing 179 spaces on Parcel D-10 itself, which are also open to the public for a fee. The largest are the Dock Square garage on Clinton Street (597 spaces); the Waterfront Garage on Milk Street (850 public spaces); and the Kilby Street Garage (700 spaces). Immediately beyond the five minute circle are an additional 3600-4500 public spaces. Figure 3 shows the locations of all public spaces within the area of Marketplace Center.

7.4 Pedestrian Circulation

The Marketplace Center development parcel is bisected by the Walk-to-the-Sea which connects the Government Center/Faneuil Hall/Quincy Market areas to the Waterfront. Large numbers of pedestrians use this walkway primarily during the noon hour, evenings and on weekends. Counts taken during the past several years show that 13,000 to 15,000 pedestrians were using this connection during these peak hours.

8. Air Quality

Massachusetts is presently classified as non-attainment for the two air quality pollutants ozone and carbon monoxide. Monitoring of local CO levels was conducted for the Dock Square EIR in 1978 and exhibited violations of the eight-hour standard in the vicinity of this project. Traffic circulation at the intersection of Commercial Street and the Under Artery (Intersection 1) the intersection of the Under Artery and State Street (Intersection 2), the parking lot on Parcel D-10, and freeflow traffic in the vicinity of Parcel D-10 was used for the air quality analysis. A prediction of existing air quality for one and eight-hour conditions showed violations of the National Ambient Air Quality Standards (NAAQS) at the eastern edge of the Faneuil Hall Marketplace and the southwestern edge of the Waterfront Park.

9. Rare or Unique Aspects of the Site

The only unique aspects of the site are its location adjacent to the Faneuil Hall Marketplace (one of the most popular marketplaces in the United States), and the Walk-to-the-Sea which passes through it.

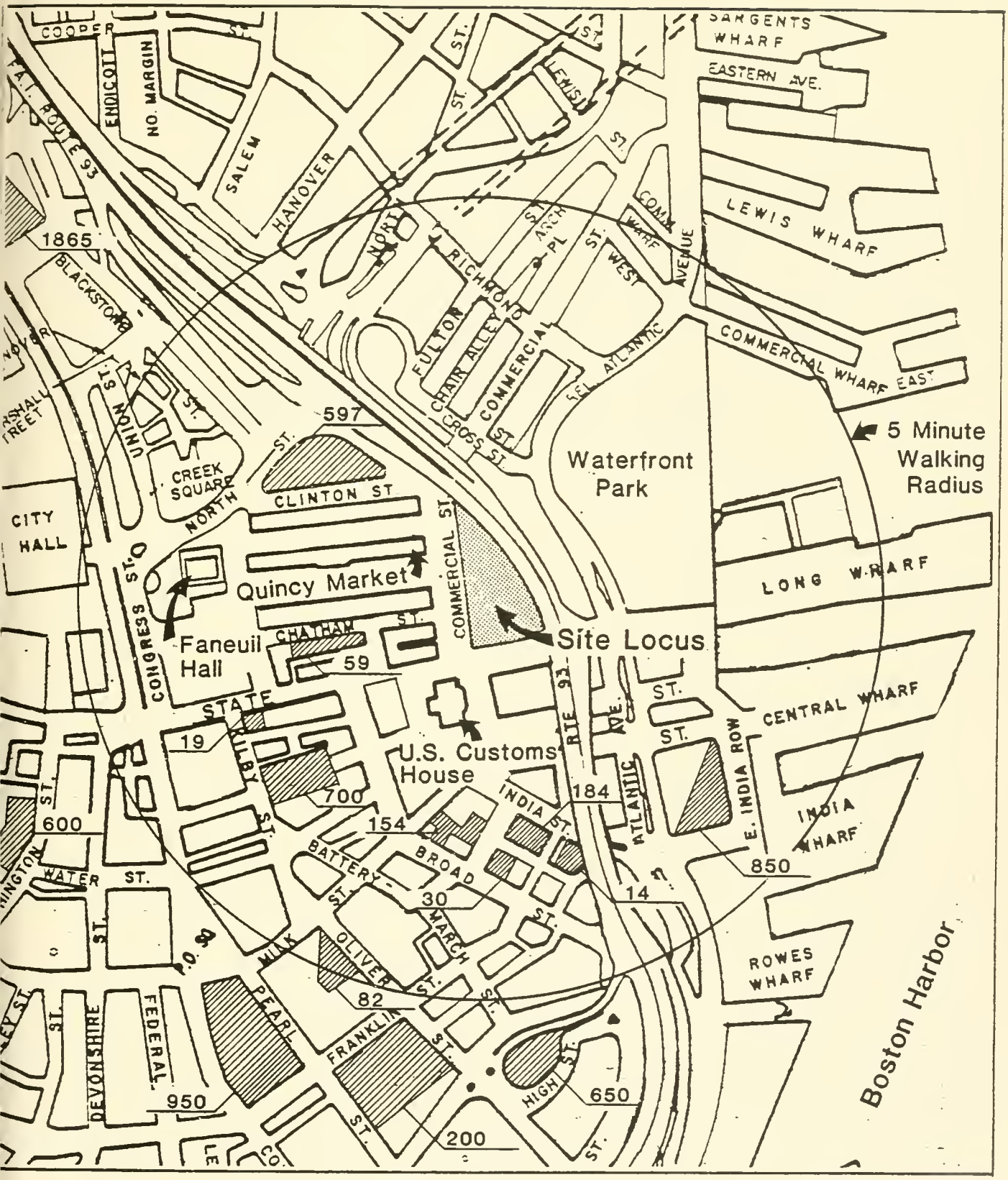


Figure 3
Public Parking

Marketplace Center

Boston, Massachusetts

Part V

Alternatives to the Proposed Project

Part V - Alternatives to the Proposed Project

The proposed site for the Marketplace Center building is owned by the Boston Redevelopment Authority. As a result, any development of this parcel must conform to the BRA's master plan and detailed development guidelines. The proposed project was selected following a design competition because of its adherence to the guidelines, off-site improvements to the Walk-to-the-Sea, and the proposal of a land lease (instead of sale) agreement. Thus, there are no alternatives in terms of use of the site; the only alternative being those design changes possible within the BRA criteria. The No-Build alternative is employed herein as a 'yardstick' against which the impacts of the proposed project may be evaluated.

Part VI

Probable Impacts of the Project and its Alternatives on the Environment

Part VI - Probable Impacts of the Project and its Alternatives on the Environment

1. No-Build

The proposed site is located adjacent to one of the most popular marketplaces in the United States; therefore, its commercial and revenue producing value is extraordinary. The No-Build option would result in the continued use of the site as a parking lot which interferes with the aesthetic integrity of the Faneuil Hall Marketplace and the waterfront district as a whole. Furthermore, employment opportunities would be lost, the City would lose revenue from taxes and leasing of the site, and Commercial Street would continue to be a barrier to the continuity of pedestrian use of the area.

The Walk-to-the-Sea passes through the site, connecting the Faneuil Hall Marketplace with the Waterfront Park. With development of Marketplace Center, this walkway will benefit substantially from improved lighting and paving beneath the Fitzgerald Expressway viaduct. Under the No-Build option, no such improvements would be made.

The proposed site is owned by the Boston Redevelopment Authority, a state agency whose mission is to plan and direct the redevelopment of the City of Boston. Continuation of the present use would be contrary to the BRA's master plan and mission.

2. Proposed Project (Marketplace Center)

A. Surrounding Area

Impacts to the surrounding area are limited to those described under the wind, shadow, traffic, air quality, noise, and visual impact sections below.

B. Wind Impacts

Marketplace Center, with its pedestrian arcade and 16-story office block, may alter pedestrian level winds and influence pressures on adjacent structures. Also, wind forces will be a major factor in determining the structural details of Marketplace Center. Due to these concerns, Marketplace Center Associates has contracted Morrison, Hershfield, Theakston, and Rowan, Ltd. (MHTR) to conduct a comprehensive wind study of the proposed building. The results of this study are presented in Appendix V.

Under this contract, MHTR has determined the frequency of significant winds in the pedestrian areas and proposed remedial measures to reduce wind speeds to acceptable levels; determined wind pressures appropriate for the design of the granite facade, curtain wall, sloped glazing, and roof surfaces; determined minimum design loads necessary to withstand wind pressures; and determined the impacts Marketplace Center will have on wind pressures at adjacent structures.

According to BRA guidelines, the probability of wind gusts in excess of 31 mph must not exceed 1%. The results of the Marketplace Center assessment indicate that the probability of such gusts will not exceed 0.446% at any of the 48 tested locations. Therefore, pedestrian level wind impacts will not exceed BRA criteria.

C. Shadow Impacts

The office tower portion of Marketplace Center, being 16 stories high, will cast some shadows in the direction of the Faneuil Hall Marketplace and other pedestrian areas. Impacts are expected to be greatest during spring and summer morning hours. A complete, four season shadow analysis has been prepared by WZMH Group Inc., the architects of Marketplace Center. Included in this analysis is an assessment of shadow impacts at 10:00 A.M., 12:00 noon, 2:00 P.M., and 4:00 P.M.

D. Visual Impacts

The Marketplace Center building will sit amidst an historic district which has important cultural resources including the Custom House, State Street Block, and the Faneuil Hall Marketplace. Because of its historic setting and high visibility from the Fitzgerald Expressway (Central Artery), Marketplace Center is a potentially important landmark in the City of Boston. The Architect, WZMH Group Inc., has designed a building which complies with the BRA's design guidelines for Parcel D-10. In so doing, WZMH Group has made a concerted effort to design a modern office/retail facility which is compatible both in mass, profile, and materials with the buildings and pedestrian spaces of the adjacent historic district.

Part of the design process has included an examination of the visual environment of which Marketplace Center will become a part. After consultations with MEPA and the Boston Landmarks Commission a number of vantage points were chosen and "before and after" views are shown. Please note that we have included visual studies for a 280 foot high building which was under study and the 220 foot building which is the subject of the Final Environmental Impact Report.

With this significant reduction in the overall height of the building, we feel that any question of the project having a

negative impact visually on the Custom House Tower has been answered. In reviewing this material, the following should be noted:

a) Marketplace Center, at 220 feet is only 44% of the height of the Custom House Tower, which is 500 feet high. By comparison, adjacent office buildings such as 60 State Street, 53 State Street, and One Post Office Square are well in excess of 500 feet tall.

b) The Floor Area Ratio (F.A.R.) of Marketplace Center is now 5.25. By comparison:

   1. F.A.R. allowed by Boston Zoning Code - 8
   2. F.A.R. called for in B.R.A. "Kit" - 6
   3. F.A.R. of Custom House Tower - 20+
   4. F.A.R. of granite State Street Block - 7.5
   5. F.A.R. of existing buildings surrounding Custom House Tower - 10-11

c) The proposed 20,055 square feet typical office floor of Marketplace Center is smaller than virtually all of the recently built office buildings in the City of Boston.

The Marketplace Center project will change the pedestrian character of Commercial Street by resurfacing it with materials more consistent with the design vocabulary of the Faneuil Hall Marketplace and by the addition of landscaping and street furniture. Commercial Street will no longer appear as a barrier between the eastern end of Faneuil Hall Marketplace and the segment of the Walk-to-the-Sea which crosses the project site. Following completion of Marketplace Center, a major courtyard/plaza will be created on the east side of Commercial Street on the Walk-to-the-Sea. This plaza is deliberately semi-circular in configuration with the Walk-to-the-Sea exiting it at the peak of its curve. The plaza may be seen as a funnel by which the pedestrian is lured from the eastern end of Faneuil Hall Marketplace and drawn along an arcade of shops and restaurants and directed to and along the Walk-to-the-Sea into the Waterfront Park.

Among the off-site improvements proposed by the Developer are lighting and pedestrian safety improvements to the Walk-to-the-Sea where it runs under the Central Artery viaduct to Waterfront Park and the adjacent Long Wharf Hotel. A lighted soffit will be installed under the viaduct to visually improve the appearance of the underside of this roadway and to greatly enhance pedestrian security, particularly at night. The Walk-to-the-Sea will be paved in brick and granite, materials consistent with its historic setting, but which are easily negotiated by the elderly, handicapped persons, and persons wearing high-heeled shoes.

E. Geologic (construction) Impacts

Construction of the Marketplace Center will involve minor de-watering (pile cap excavations only) and pile driving. Since de-watering will be limited to pile cap excavations only, no subsidence of soils is expected to occur outside of the excavation. All pile locations will be pre-augered to remove any threat to the structural integrity of foundations of adjacent structures and the MBTA Blue Line tunnel beneath State Street.

F. Archaeological Impacts

An archaeological survey of the site was conducted prior to construction and any recovered artifacts will be removed (if feasible) and if of cultural significance, protected. Therefore, no impacts to the archaeological record are anticipated.

G. Impacts to Utilities

G.1 Existing Structures

The Marketplace Center project will require the removal of abandoned underground utility systems and the relocation or incorporation of active systems. Since March 1982, the architects of Marketplace Center have been meeting with representatives of the utilities involved (e.g., Boston Gas, Boston Edison Steam Division, Boston Edison Distribution Division, New England Telephone and Telegraph, Boston Fire Department, and Boston Water and Sewer Commission) to resolve these issues. Memoranda of these meetings, arranged chronologically by utility, are presented in Appendix IV.

Any relocation of utilities will require the approval of the Public Improvements Commission as described in Project Memorandum No. 5 (Appendix IV). P.I.C. plans are currently being prepared in conjunction with the Boston Public Works Department.

Boston Gas

Gas Lines which will be affected in any way by construction are:

a) Two 6 inch lines within the parcel boundaries which have already been abandoned and may be removed by the Developer.

b) An existing 12 inch line in Commercial Street which may be in conflict with a 12 inch U.C.P. sewer line in Commercial Street. Since this sewer alignment will cross the existing 12" gas line (cast iron) at a very slight angle, the possibility of retaining the gas line

as is during the construction of the sewer line is at question.

The Gas Company will allow a temporary capping of the line in the construction Area if the demand on the line is low (warm weather). If the line is capped, construction of the sewer line then can be accomplished without conflict. After the sewer line is installed, a new steel gas line will be installed, replacing about 80' of cast iron pipe. The period of time to complete this portion of construction should not be more than a week.

c) A 4 inch I.P. plastic line in Commercial Street which conflicts with a proposed drain manhole in Commercial Street opposite South Market Street. The constsruction of this M.H. at this location is critical because it is being constructed over an existing drain line. It has been agreed to let the field engineer determine the exact degree of conflict during construction. Two options will be available. One is to offset the manhole opening and the second is to construct a section of 4" plastic line around the proposed structure which would only require 10 to 15 feet of new line.

d) A 30 inch gas line parallels, but is outside of the Westerly property line. The piles and pile caps of Marketplace Center have been designed so there is no conflict with this line, and furthermore the Contractor has met with Boston Gas to outline plans so that every possible means will be undertaken during construction to protect the line.

Boston Edison (Steam)

A 16 inch diameter steam line passes beneath the D-10 parcel south of the Walk-to-the-Sea. This is the trunk line from the central plant on Kneeland Street which provides heat to City Hall, the Faneuil Hall Marketplace and many other buildings. Because of the importance of this line, Marketplae Center has agreed, despite expense and inconvenience, to incorporate this line within the underground parking garage. The existing line will remain in operation during construction with no disruption of service. MCA's engineers have worked diligently with their counterparts at Edison Steam to arrive at this imaginative solution.

Boston Edison (Electric)

All electric lines beneath the parcel are abandoned or scheduled to be abandoned. The electrical vault at the southwest corner of the site will be relocated to the vault

in front of the South Market building.

New England Telephone and Telegraph

No active telephone services are located beneath the D-10 parcel. A 20-duct conduit bank lies beneath the eastern side of Commercial Street at the northern end of the site, but there will be no disturbance of this line during construction.

Boston Fire Department

Some hydrants within the area slated for construction will be relocated. The new locations have been determined as part of a continuing review process with the Boston Fire Department.

Boston Water and Sewer Commission

Water and sewer lines exist beneath the parcel, including a section of old wooden sewer. All of these lines either will be relocated, removed, or incorporated into the Marketplace Center Building. The 54-inch storm drain and 48-inch sewer lines will be protected during construction and will remain in their present location. The 24-inch high pressure water main, which lies beneath the eastern edge of the parcel, will be removed and reinstalled within the underground parking garage. The wooden sewer will be removed and portions may be salvaged if it is shown to have historic value.

G.2 Water Use

Without the installation of water-saving devices, water use at the site is expected to be 41,215 gpd. This consumption will be reduced significantly by the installation of aerating nozzels, spring-handle faucets, and tankless toilets. The New England River Basins Commission reported these savings to be 30 percent for aerators and 40 percent for tankless toilets.[1] No value for spring-handle (automatic shut-off) nozzels was reported. Since most water use in Marketplace Center will occur using these fixtures, savings in water consumption will be 30 percent at a minimum. Therefore, actual water use will be approximately 28,850 gpd or less.

G.3 Sewage Disposal

Sewage generation from Marketplace Center is estimated to be 41,215 gpd. With the installation of water-saving devices (given a minimum efficiency of 30%) the sewage generation will be 28,850 gpd.

To avoid overloading of the sewers, a holding tank will be installed to regulate the timing of sewage release (i.e., two hours before low tide or two hours after low tide). The tank has been sized and designed according to the requirements of the Massachusetts

1 New England River Basins Commission. 1980. Before the well runs dry: a handbook for designing a local water conservation plan. NERBC

Division of Water Pollution Control and the Boston Water and Sewer Commission, and will be of sufficient design to prevent the intrusion of floodwater and seepage during a 100-year flood event. Since any sewer and water supply tie-in will require the issuance permits from the Boston Water and Sewer Commission, this agency will approve the final design.

H. Transportation and Traffic

H.1 Street and Highway Network

With the development of Marketplace Center, the only change in the existing circulation system will occur on Commercial Street between Clinton Street and Chatham Street which will be closed to general traffic. Access to existing developments for service purposes will be retained under an arrangement similar to that in effect at Downtown Crossing.

Because of the closing of this street to general traffic, the vehicular entrance to the proposed development will be on the Under Artery Roadway between State Street and the Walk-to-the-Sea. Refer to Appendix I of this report for a description of the traffic projection methodology used in determining the anticipated traffic volumes for the project.

No Build Traffic Volumes 1987

Existing volumes (1982) within the Marketplace Center project area were increased at an average annual rate of 0.5% to develop the anticipated traffic volumes under the No Build condition for the year 1987. The land use is a parking lot (179 spaces) which is accessed via Commercial Street and operates at full capacity. Therefore, vehicle trips to the site for 1987 No Build along Commercial Street are the same as 1982 Existing conditions.

Build Traffic Volumes 1987

The 1987 No Building traffic volumes were used as a base to determine traffic volumes from the proposed development. The first step in the process was to remove the existing site generated trips from the immediate vicinity of the project. It was then necessary to reassign the remaining traffic to the proposed network i.e, Commercial Street closed to general traffic. Finally, the anticipated project generated traffic was assigned to the network. Specific assumptions made in the assignment process were:

- One half of the afternoon peak hour inbound traffic would use the on-site garage.

- One half of the capacity of the garage, approximately 60 vehicles would leave in the PM peak hour. The remaining traffic generated by the project in the peak hour would use other garages and lots within the vicinity. Appendix I presents specific turning movements for each of the development options.

Intersection Capacity Analysis

An analysis of the major intersections has been prepared to assess the impact of the Marketplace Center project on the surrounding street systems. The nature of the network is such that there will be a rapid dissipation of site generated traffic to the nearby expressway and arterial street system.

All of the Marketplace Center site specific traffic will be concentrated on the southbound segment of the Under Artery roadway between Clinton Street and State Street. This is due to the location of the parking garage exit and entrance on the Under Artery. However, a median break opposite the garage exit on the Under Artery as a means of redistributing traffic is inappropriate due to poor roadway geometry.

Capacity Calculations

Each of the major impacted intersections has been analyzed for the peak hours for the Existing conditions, the 1987 No Build conditions and the 1987 Build conditions. The format used was adopted from the Highway Capacity Manual[2] and evaluates a proposed street system which includes the closing of Commercial Street to general traffic from Chatham Street to Clinton Street.

The method used was to assume that each intersection would operate at Level of Service C, an assumption which is standard for an urban area such as Marketplace Center. Using a series of factors based upon the number of left and right turns at each intersection, the percentages of trucks and busses passing through the intersection, the existence of curb parking or no parking areas, and the width of each approach; a theoretical capacity was determined of each approach of each intersection. This was then compared to the actual demand volume of traffic during the P.M. peak hour to determine the Level of Service of the intersection. It is important to understand that Level of Service (LOS) is a subjective description of traffic flow quality. The definitions of LOS are as follows:

2. Highway Research Board. 1965. Highway Capacity Manual. Highway Research Board.

Descriptions of each of the intersections follow.

Blackstone Street/North Street/Southbound Off-Ramp

This intersection currently operates on an E Level of Service in both morning and evening peak hours. No significant changes in volume/capacity ratios or Level of Service are anticipated under either the No Build or Build conditions. (Table 2)

Clinton Street/Commercial Street/Under Artery

Levels of Service at this intersection are currently at A in the morning peak hour and D in the evening peak hour. With the closing of Commercial Street to general traffic and the shifting travel patterns, anticipated Levels of Service will be B in the morning and B in the afternoon (Table 2)

State Street/Under Artery

Currently at an A and a B Level of Service in the morning and evening peak hours, respectively, no significant changes are anticipated under the No Build condition in 1987. Upon construction of Marketplace Center, it is anticipated that parking will be eliminated from the southbound portion of the Under Artery roadway between the Walk-to-the-Sea and the new garage entrance/exitway. The sidewalk in this vicinity will be widened into the existing parking lane to increase site distance at the garage entrance. Even with the reduction of approach width at this location, no significant changes in Level of Service or volume/capacity ratios are anticipated.

TABLE 2

Existing and Anticipated Levels of Service (V/C)

	AM			PM		
	Existing	No Build	Build	Existing	No Build	Build
State/ Under Artery	A/.568	A/.580	A/.585	B/.683	B/.700	B/.657
Clinton/ Commercial	B/.604	B/.616	B/.627	D/.811	D/.826	B/.678
Black-stone/ North E.	E/.916	E/.936	E/.986	E/.978	E/1.0	E/.981

PARKING

Parking

As stated in the Draft EIR, the construction of the Marketplace Center Project will result in a shortfall of 380 to 580 parking spaces each day. These parking needs will have to be accommodated at other off-street facilities within the immediate vicinity. A field survey of 15 parking facilities located within a five to eight minute walk of the project site was conducted on October 7, 1982 between the hours of 10:30 A.M. and 1:05 P.M in order to estimate the occupancy rate of an average day. The results of this survey are attached and indicate an average occupancy rate of 65%.

These 15 facilities, 12 of which are located within a five-minute walk of the Marketplace Center site, are representative of all parking facilities in the area. They are not, however, all the potential parking spaces within a five to eight minute walk of the site. Approximately 3,450 additional spaces are available at other facilities (i.e., Government Center Garage, 15-99 Cross Street, Woolworth Garage, and 237 Washington Street), bringing the total number of parking spaces within a five to eight minute walk of the site to approximately 7,300.

The survey of 15 facilities within a 5-minute walking distance of the locus showed an availability of 1,308 spaces. This availability was an average utilization of 65% for the facilities surveyed. If a worst-case utilization factor of 85% were assumed, approximately 580 spaces would be available within the fifteen facilities surveyed, some 1,100 among all major off-street facilities within the 8-minute radius. Thus, there is adequate available parking capacity in existing facilities within 8-minute's walk to absorb the residual parking needs of Marketplace Center.

PUBLIC PARKING AVAILABILITY SURVEY*

Facility Number	Type	Location	Licensed Capacity	Spaces Occupied	Residual Capacity
1	Garage	Clinton Street	597	380	217
2	Lot	57 Chatham Street	32	29	3
3	Lot	52-56 Chatham Street	41	50	-9
4	Lot	73-79 State Street	19	15	4
5	Garage	30 Kilby Street	700**	-	-
6	Garage	1 Post Office Square	82	70	12
7	Lot	156-158 High Street	60	66	-6
8	Garage	130-162 Congress Street	950	850	100
9	Garage	142-150 High Street	200	175	25
10	Garage	90 Oliver Street	650	175	475
11	Garage	41-49 India Street	184	72	112
12	Lot	163 Custom House Street	154	92	62
13	Lot	5-11 Custom House Street	30	54	-24
14	Lot	53-59 India Street	14	27	-13
15	Garage	65 India Wharf	850	500	350
TOTAL			3,863	2,555	1,308

*Survey was conducted on October 7, 1982 between the hours of 10:30 A.M. and 1:05 P.M.

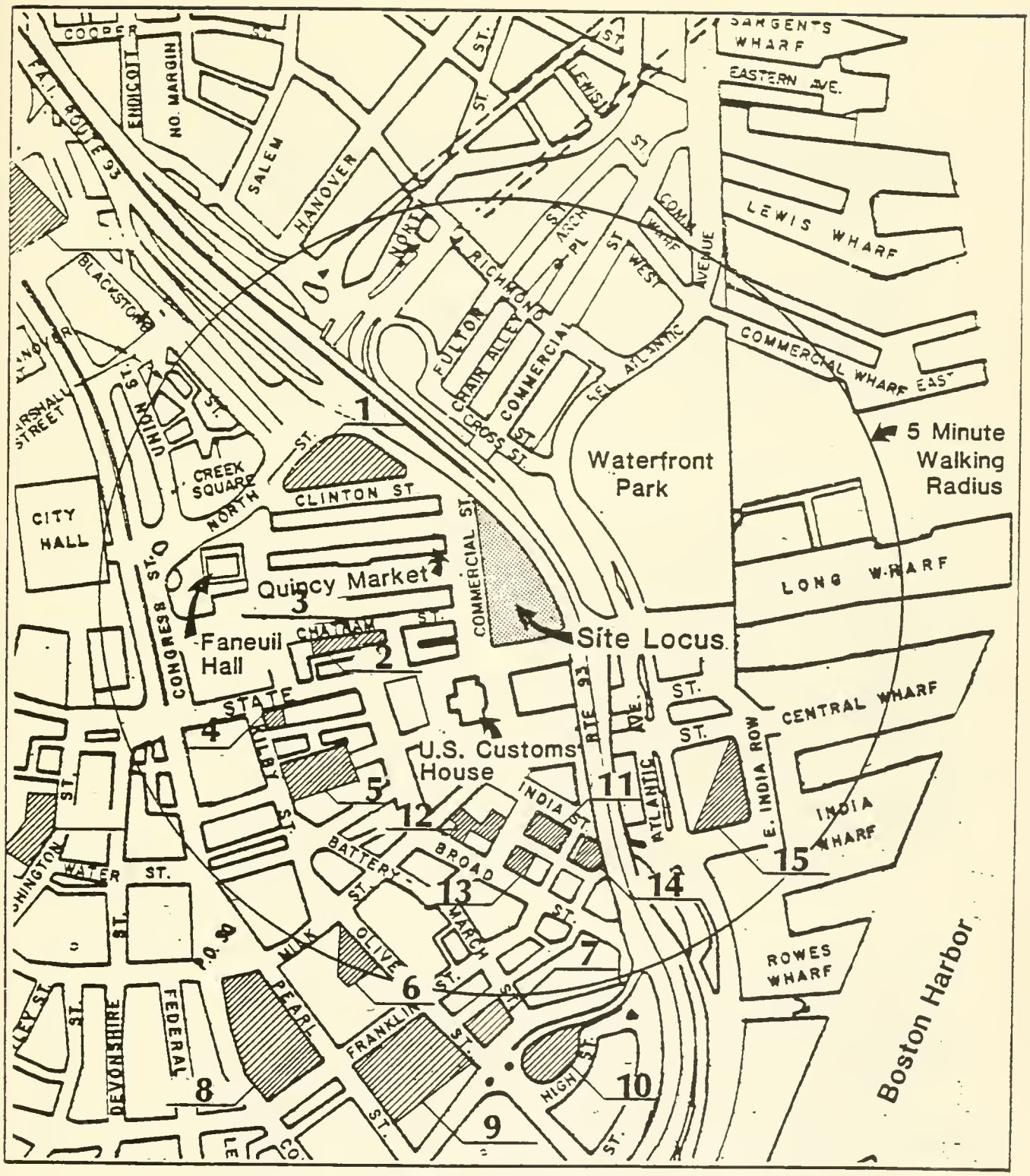
**Not included in total.

NOTE

The 700 car Kilby Street Parking Garage was being offered as a development site by the Boston Redevelopment Authority in conjunction with the Real Property Board and the Public Facilities Commission of the City of Boston. Although the existing elevator garage, which is very inefficient and causes backups on Kilby Street, will be demolished, the development "Kit" for the site clearly states that:

> "A minimum of 700 public parking spaces must be provided to replace those currently in the Kilby Street Garage."

Submissions are currently being evaluated by the City of Boston, but as yet there is no timetable for demolition or new construction.



1 Parking Areas

0 200 400 ft

Sasaki Associates, Inc.

Figure 3
Public Parking

Marketplace Center
Boston, Massachusetts

Truck and Taxi Traffic

Surveys have found that 3% of office non-employee arrivals by auto were taxi passengers or were drop-offs by drivers who proceeded elsewhere. With regard to Marketplace Center, this translates to approximately 12-15 taxi arrivals per day.

Daily truck generation rates anticipated for this development are 0.21/1,000 g.s.f. of office space and 0.24/1,000 g.s.f. of retail space, resulting in approximately 93 truck arrivals per day. Of these, approximately 12-13 will occur in the peak truck hour (9:30 - 10:30 A.M.).

Parking

1. Off-Street

The existing 179 public off-street spaces are to be replaced with 120 new spaces, all of which will be reserved for the exclusive use of the building tenants and therefore not conflict with requirements of the Downtown Boston parking freeze. The demand for parking spaces anticipated by the development will result in a shortage of 200-400 spaces over the course of the day. When added to the existing 179 public spaces to be eliminated, the project will result in the demand for 380 to 580 off-site parking spaces. As stated previously, there are approximately 7,300 public spaces existing within a 5-8 minute walk of the project. The overflow from Marketplace Center will result in a 5% to 8% increase in the utilization of these spaces.

2. On Street

Currently, the City of Boston policy generally prohibits on-street parking downtown before 9:30 AM. Because of this restriction, as well as the stepped up parking enforcement program, it must be assumed that morning peak hour demands which cannot be accommodated on-site will necessarily find off-site spaces in the immediate vicinity of the project. Off peak demands may find on-street spaces on a first come, first serve basis, and will obviously create an increased demand for the already limited numbers of on-street spaces.

I. Air Quality

I.1 Short-Term Impacts

During the construction phase of Marketplace Center, rerouted traffic and truck detours will alter normal

traffic circulation patterns subsequently having an effect on local air quality. These conditions will probably result in elevated carbon monoxide concentrations in the vicinity of Faneuil Hall Marketplace and the Waterfront Park. However, unhealthy air quality conditions will occur only during winter months when meteorological conditions are more conducive to adverse carbon monoxide levels. Therefore, fewer individuals are likely to be exposed to adverse air quality conditions due to the decrease of outside activities during winter months. Additional emissions from stationary construction equipment will insignificantly elevate carbon monoxide and total suspended particulates near Faneuil Hall Marketplace. Air quality deterioration due to construction activities will be of short duration lasting from 1982 to 1983.

I.2 Long-Term Effects

Traffic circulation will be significantly altered in the vicinity of the project due to the automobile restriction placed on Commercial Street and the installation of an enclosed parking garage with access and egress off the southbound lane of the Under Artery. Carbon monoxide concentrations were predicted at two air quality sensitive receptors using the traffic information above. The loss of vehicles on Commercial Street, as well as the Marketplace Center Building acting as a barrier to winds from the northeast to southwest will result in a significant decrease of carbon monoxide concentrations at the eastern end of Faneuil Hall Marketplace.

The enclosed garage will have a ventilation system which will expel emissions through two exhaust ducts at a height of 6.7 meters above ground on the east facade of the Marketplace Center building. These emissions were analyzed as an area source and were found to have a negligible effect on carbon monoxide concentrations in the vicinity of the two sensitive receptors.

The exiting vehicles from the enclosed garage were incorporated into the traffic projections at the intersection of State Street and the Under Artery. A carbon monoxide analysis was performed and resulted in similar one and eight hour concentrations to 1987 No Build Conditions.

The results of the 1987 Build analysis were well below the one (35.0 ppm) and eight-hour (9.0 ppm) standard for carbon monoxide. Therefore, the project is unlikely to result in unhealthy local air quality conditions.

J. Noise

J.1 Short-Term Impacts

The area within the vicinity of Marketplace Center is already exposed to high ambient noise levels. During the construction phase of the project, this area will be subject to additional noise intrusions from construction equipment and trucks travelling to and from the site. The Air Pollution Control Commission of Boston has designed regulations in an effort to minimize intrusive noise for different land uses. These regulations are presented in Appendix VI. There are special provisions for construction sites which state that noise measured at the lot line must not exceed 80 A-weighted decibels over ten percent of the measurement interval.

Sound level meters are equipped with filters which allow the passage of certain frequencies. A weighting refers to the use of the filter which best represents noise frequencies which are most annoying to the human ear.

Many of the non-impact equipment used on this site such as backhoes, scrapers, cranes, etc. will exceed the 80 A-weighted decibel limit at a distance of 50 feet. Therefore methods to attenuate noise from certain construction equipment will have to be implemented. Impact equipment which will be used extensively will consist of pneumatic wrenches, and pile drivers and to a lesser extent jack hammers and rock drills. This equipment has the potential of elevating ambient noise levels above 80 decibels fifty feet from the activity. Conventional pile driving techniques result in peaks over 100 decibels as well as cause subsurface vibration waves depending on soil conditions.

The trucks travelling to and from the site will also elevate noise levels above ambient background levels. Noise levels (approximately 70 decibels) near this site can be raised 20+ decibels during truck "pass-by", a change which is perceived as more than a doubling of noise. The constant truck delivery could contribute to annoying noise peaks during business hours at the Faneuil Hall

Marketplace. Therefore, the implementation of methods to minimize construction noise is recommended (Part VII, 9.1).

J.2 Long-Term Impacts

The construction of the project is not anticipated to create any new major generators of noise. The building equipment used for air regulation (conditioning and humidifying) and water/fluid circulation can elevate interior noise levels. However, proper design techniques can minimize the intensity of this source resulting in imperceptible noise disturbances.

The proposed project will result in a net loss of local traffic. For instance, there will be an automobile restriction on Commercial Street as well as a lowered parking turnover rate on Parcel D-10. This loss will have an imperceptible effect on the Waterfront Park as most of the noise in this vicinity is generated by traffic on the Central Artery and Atlantic Avenue, yet significantly lower noise in the vicinity of Faneuil Hall. Additionally, the proposed building will attenuate traffic noise from the Central Artery and Under Artery resulting in significant noise decreases at the eastern end of Faneuil Hall Marketplace. As this area is used extensively for outside activities, the proposed project is clearly a benefit to the overall noise climate in this area.

K. Energy Use

All mechanical engineering (heating, air conditioning, electrical and plumbing) for Marketplace Center has been done by Cosentini Associates, and choosing one firm to do all this work has resulted in an unusually well coordinated total system.

Cosentini Associates is one of the best known and widely respected mechanical engineering firms in the United States. In today's economy, it is very much in the Developer's own interest to design a system which is as energy efficient as possible, so a very brief listing of some of their recent clients for office buildings should further illustrate their "state of the art" approach:

A T & T Headquarters - New York
Johnson/Burgee - Architect

Dallas Centre - Texas
I. M. Pei & Partners - Architects

U. N. Office Building - New York
Kevin Roche - Architect

Johnson & Johnson Headquarters - New Jersey
I. M. Pei & Partners - Architects

The enclosed material discusses operable windows and solar panels, and explains why they were not used.

L. Special Construction Impacts

The location of Marketplace Center is highly visible due to its proximity to one of the most popular pedestrian spaces in the United States, the Faneuil Hall Marketplace. Because the Marketplace is perhaps Boston's most popular tourist attraction, it is important that the construction of Marketplace Center be conducted in an exemplary fashion such that the enjoyment of the City of Boston by tourists and residents alike is subjected to minimal disruption and inconvenience.

The construction of Marketplace Center will cause noise, generate dust, disrupt the continuity of the Walk-to-the-Sea, as well as be somewhat of a visual intrusion to the area. During the anticipated 22 month construction period, some minor traffic disruptions can also be expected due to the loss of the 179 space parking lot now occupying the site. There will be disruption of on-street parking which occurs on the surrounding streets, as well as some reduced traffic capacity due to the unavoidable spillover of construction materials and equipment from the site.

The Rouse Company dumpster, which is within the structure now at the northerly end of the site, will remain in continuous operation during construction within the temporary construction fence. Upon completion of the building, service functions for Rouse will be incorporated into Marketplace Center.

L.1 Schedule

Marketplace Center is to be constructed over approximately 22 months, commencing in June 1983. This schedule includes four phases of work:

1.	Excavation and foundation	5 - 6 months
2.	Steel erection	6 - 7 months
3.	Enclosure	5 - 6 months
4.	Finishes	4 - 5 months

SETBACK FROM CENTRAL ARTERY

SA

Sasaki Associates, Inc., 64 Pleasant Street, Watertown, Massachusetts 02172 · (617) 926-3500 Telex 92-2471

RE: Marketplace Center DEIS
SA #2026.01

MEMORANDUM: BY: Ed Fitzgerald DATE: 21 May 1982

TO: Larry Carr, Brad Saunders

As requested by Larry, I inquired of the Layout Section of the Mass. D.P.W. regarding any restrictions, easements, etc., that might affect the proposed program of Marketplace Center. Apparently, the client's architect was advised by staff of the BRA that an easement may exist between State and Clinton Streets.

Al Sheehan of the MDPW called me on 5/20/82 after researching the issue. In general, Sheehan advised me of the following:

All lands originally taken by the Commonwealth for construction of the Central Artery between Causeway Street (North Station) and the Dewey Sq. Tunnel, that were no longer necessary for highway purposes, were deeded to the City of Boston after construction of the Artery. This included any land outside the physical limits of the Artery or its ramp systems. While the City may own these lands in fee, the Commonwealth has reserved certain rights to the land in order to operate, maintain, repair, replace, etc. The Commonwealth has also retained the right to approve or disapprove control of traffic at street level under the Artery.

The only easement Sheehan could find reference to in the area was a 1951 removal easement. However, this type easement is only temporary while the existing structure(s) is (are) removed.

Sheehan made prints of layout No. 5075 which includes the area from North Street to Congress Street. You can make arrangements to pick this up through Joe McHugh of the MDPW (727-4768). (Use my name).

Your client should contact the Right-of-Way Division of the MDPW as soon as possible in the event certain actions are required by the State because of the proximity of the project to the Artery.

This early-on contact could then assure that the proposed program can continue on schedule.

bb/2026.01

MEETING REPORT

July 7, 1982

Mass. D.P.W.

On all survey drawings obtained from the B.R.A. and then verified by our own surveyor, a Mass. D.P.W. "no build" line was clearly shown.

In conjunction with Alfred Howard, Chief Transportation Planner of the B.R.A., on July 7, 1982 a meeting was held at the Mass. D.P.W. with Deputy Chief Engineer Sholock and Engineers Gardiner and Oliver. The D.P.W. stated that extensive re-construction of the central artery would probably be occuring within the next 3-5 years but that no definite plans existed. They did verify the existence of the "no build" line as shown on the survey plans, and noted that, at one corner of the tower of Marketplace Center there was an 8-12 inch intrusion over the line.

Because of this, Marketplace Center Associates instructed its architects to redesign the tower so that there is no intrustion whatsoever over the "no build" line.

Alfred Howard, who is the B.R.A. liaison with Mass. D.P.W. is part of the ongoing design review process.

Part VII

Measures to Minimize Environmental Damage

Part VII - Measures to Minimize Environmental Damage

1. Surrounding Area

Measures to minimize impacts to the area surrounding Marketplace Center are described under the wind, shadow, visual, traffic, noise, and air quality impact sections below.

2. Wind Impacts

The extensive wind tunnel testing for Marketplace Center was carried out by Morrison Hershfield Ltd. (formerly MHTR Ltd.) of Ontario, Canada under the direction of Dr. Peter Irwin a widely recognized and published authority in the field of wind analysis.

The testing program was carried out for the 21 story building which was the subject of the Draft, and Supplement to the Draft, E.I.R. Since pedestrian level winds are very much a factor of the height of the building, it was natural to assume that wind effects would be diminished as the height is reduced. It should be emphasized that the basic configuration of the building at its top and bottom has not changed. The five floors were, essentially cut out of the middle of the office block, so the general configuration of the project is unchanged, except it is much shorter.

The enclosed letter from Morrison Hershfield Ltd. explains why additional wind testing is not necessary.

In response to specific questions raised after the review of the Supplement to the Draft E.I.R.

a. Location #7 represents a small area in the middle of Commercial Street between Chatham and State Streets. At this point the street will be open to normal traffic - the limited access/pedestrian zone begins north of Chatham Street. Because Marketplace Center will have a lively arcade with shops running along Commercial Street it is doubtful that any significant pedestrian actively will occur in mid-block in the middle of an active street.

   The reduction in the height of the building will result in a 5-10% drop in wind speeds at this location.

b. Locations 17 and 19 are under the glass canopy on the "Walk-to-the-Sea". The design purposely does not include glass walls at this point precisely because this vital pedestrian spine must be perceived as totally open to the public at all times. It is our feeling that with an overall reduction in pedestrian level winds due to the reduction in height of the building, the wind speeds will be reduced by 5-10%.

Complete accuracy at these locations is impossible because of the scale heights involved, especially regarding the structure of the Central Artery. As proposed for location 18, if problems occur during winter months, we propose to have a series of moveable planters with coniferous shrubs which could be rearranged to mitigate isolated problems.

c. Regarding wind velocities at locations 12, 20, 45, 46, 16 and 19, there will be an across the board reduction of 5-10% because of the reduced height of the building. We note that in most of these locations there was not an appreciable increase in wind speed over the existing conditions, and in no case is the BRA limit of 31 mph exceeded.

d. Location #40, at the easterly end of North Market Street was not modeled "with remedial solutions" because of a mechanical malfunction with the test probe. In any event, there is a significant improvement with the building itself over the existing condition. The lessening of the height will further improve the situation, as will the planting of trees along Commercial Street which will be done as part of the approved landscaping plan.

Summary:

The following items have been included in the project to mitigate wind effects.

a. Eleven Austrian Pine trees, thirty feet in height will be planted along State Street.

b. As per the landscaping plan approved by the BRA, nine inch caliper Honey Locust trees will be planted along Commercial Street.

c. Movable tubs with coniferous shrubs will be used where needed in the "Walk-to-the-Sea" area.

d. There are pedestrian arcades along State Street and Commercial Street.

e. The low rise element of the building has been moved southward to the back of the State Street sidewalk.

f. The building has been reduced in height from 280 feet to 220 feet.

Morrison Hershfield Limited
Consulting Engineers

RECEIVED
APR 07 1982

April 6, 1983

Mr. James F. Sullivan
Marketplace Center Associates
189 State Street
Boston, MA 02109
U.S.A.

Re: Marketplace Center, Boston

Dear Mr. Sullivan:

Further to our telephone discussion with Chung Lee of WZMH Group Inc. on March 31, 1983, we are writing to give our recommendations on the effect of the recent five floor height reduction of the above project on the results of our wind tunnel studies. We have now received updated drawings dated March 24, 1983.

Pedestrian Level Winds

The general effect of the height reduction would be to slightly lessen the impact of the project on pedestrian level winds. However, we would judge that the effect would not be sufficient to eliminate the need for the remedial measures that were developed in the model testing. Therefore, we recommend no changes to the remedial measures described in our Report 4821991.

Wind Loading

The height reduction would tend to reduce the wind pressures and suctions on the exterior surfaces of the tower, making the design information provided in our Report 4821401 slightly conservative. We estimate the reduction to be no more than about 10%. Report 4821401 showed that the wind loading on nearby structures was not adversely affected to any large extent

650 Woodlawn Road West, Guelph, Ontario N1K 1B8, Telephone (519) 823-1311, Telex 069-56639
Edmonton Guelph Toronto

by the Marketplace Center in its earlier form. The height reduction would merely lessen its impact further in this regard.

Should you wish to discuss these matters further please feel free to contact us at your convenience.

Yours very truly,

MORRISON HERSHFIELD LIMITED

P.A. Irwin, Ph.D., P.Eng.
Director of Technical Services

PAI/ie
482-199

3. Shadow Impacts

Any building casts shadows, and in an urban setting, there are often complex and overlapping shadow patterns as the sun moves across the sky.

The only shadow impacts caused by the construction of Marketplace Center will be in mid-morning on Commercial Street and on a small portion of what is called Waterfront Park in late afternoon during the winter.

a. Commercial Street - Anything above a three story building on Parcel D-10 will impact Commercial Street for a short period of time in the morning. However, during those hours Commercial Street will be used as a service street for the many trucks which serve the Faneuil Hall Markets. At mid-day, when the greatest concentration of pedestrians are in the area, it is the Custom House Tower itself which puts Commercial Street into shadow.

b. Waterfront Park - In winter, when few people use the park, it is impacted in late afternoon by virtually all the buildings in the area, including the Custom House Tower and the historic State Street Granite Block. The grassy plot immediately adjacent to Atlantic Avenue, which is most impacted by Marketplace Center is, in reality, not a part of the park. It is a development parcel which was created in the late 1970's by a committee which brought about, through legal action, changes to the Waterfront Urban Renewal Plan of 1964. This committee was made up of representatives of the Waterfront Residents Association, the North End, the B.R.A. and many other groups including the Sierra Club.

In terms of Marketplace Center, several design features lessen overall shadow impacts:

a. The setback of the office element from Commercial Street.

b. The setback of the third story along Commercial Street.

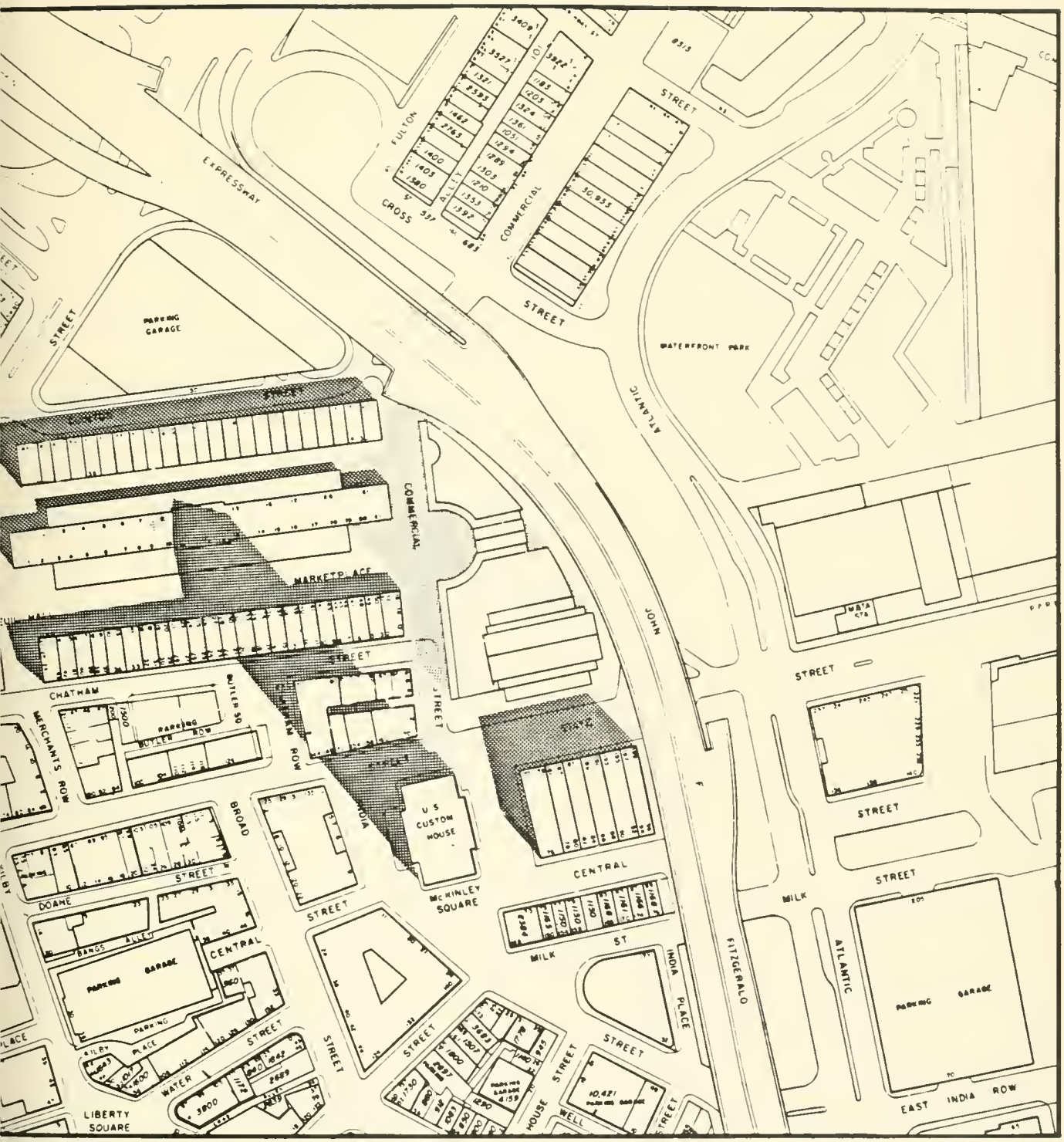
c. The creation of a large public plaza within the site at the end of South Market Street.

d. The sensitive shaping of the top of the office building with setbacks and a pitched roof which allow more light into the surroundings than would a "squared off" building built to the same allowed height.

Included are shadow studies done for the previous 280 foot high building as well as for the current 220 foot building which is the subject of this E.I.R.

SHADOWS FOR PREVIOUS

280 FT. BUILDING



MARKETPLACE CENTER

STON MA

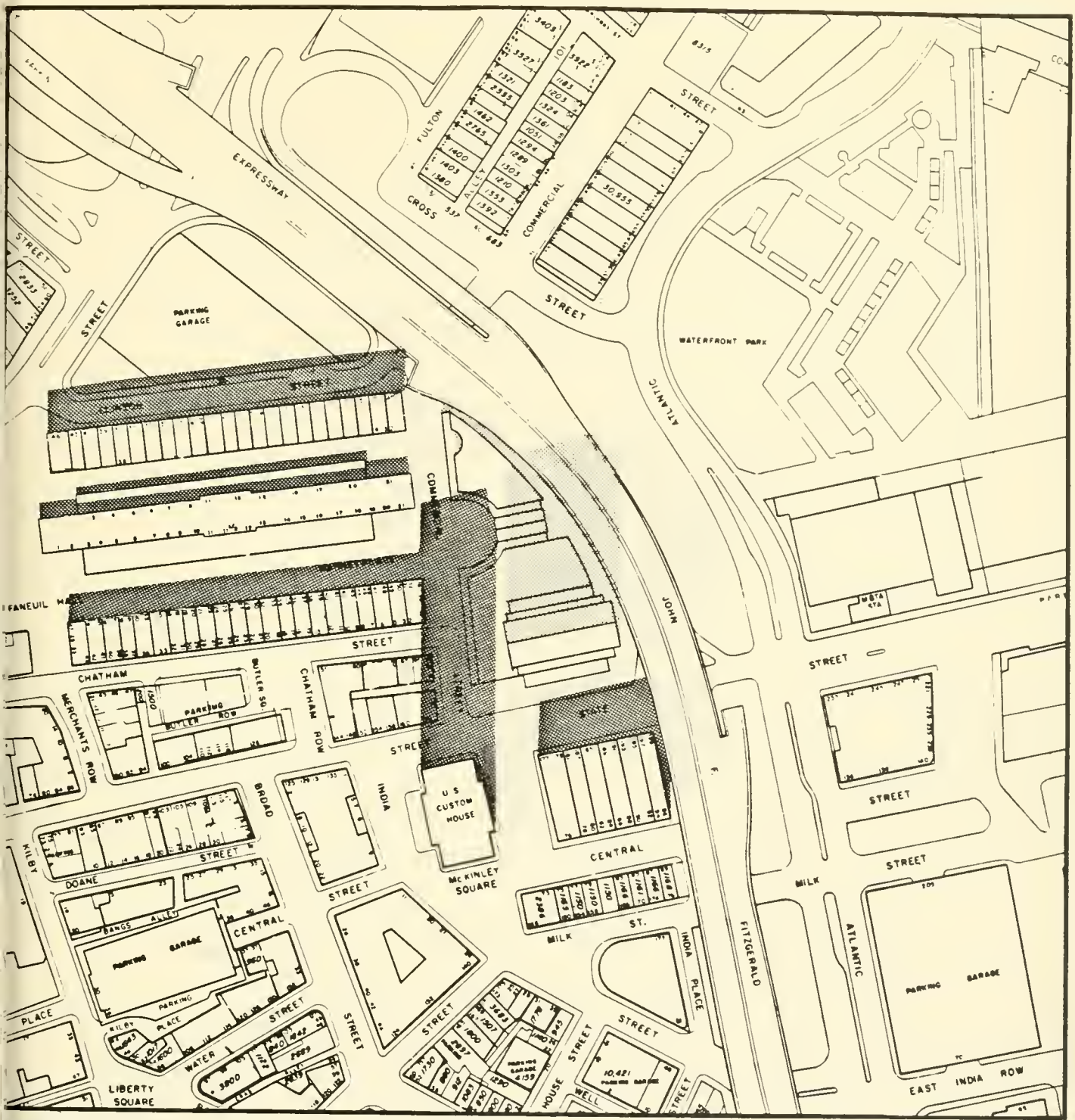
HADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE MARCH 21/ SEPT. 23 TIME 10:00 AM



MARKETPLACE CENTER

BOSTON MA

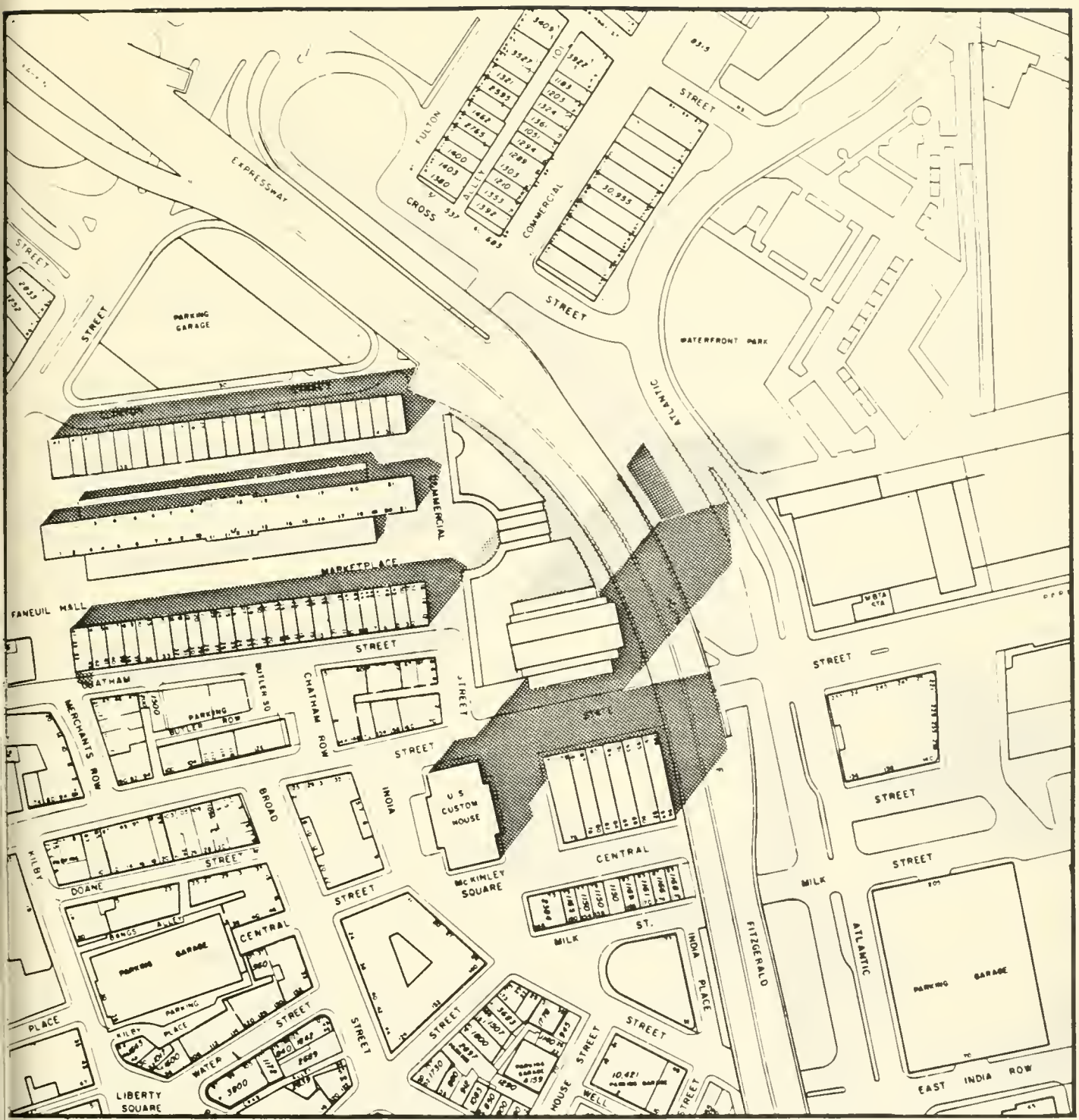
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: MARCH 21/ SEPT. 23 TIME: 12:00 AM



MARKETPLACE CENTER

BOSTON MA

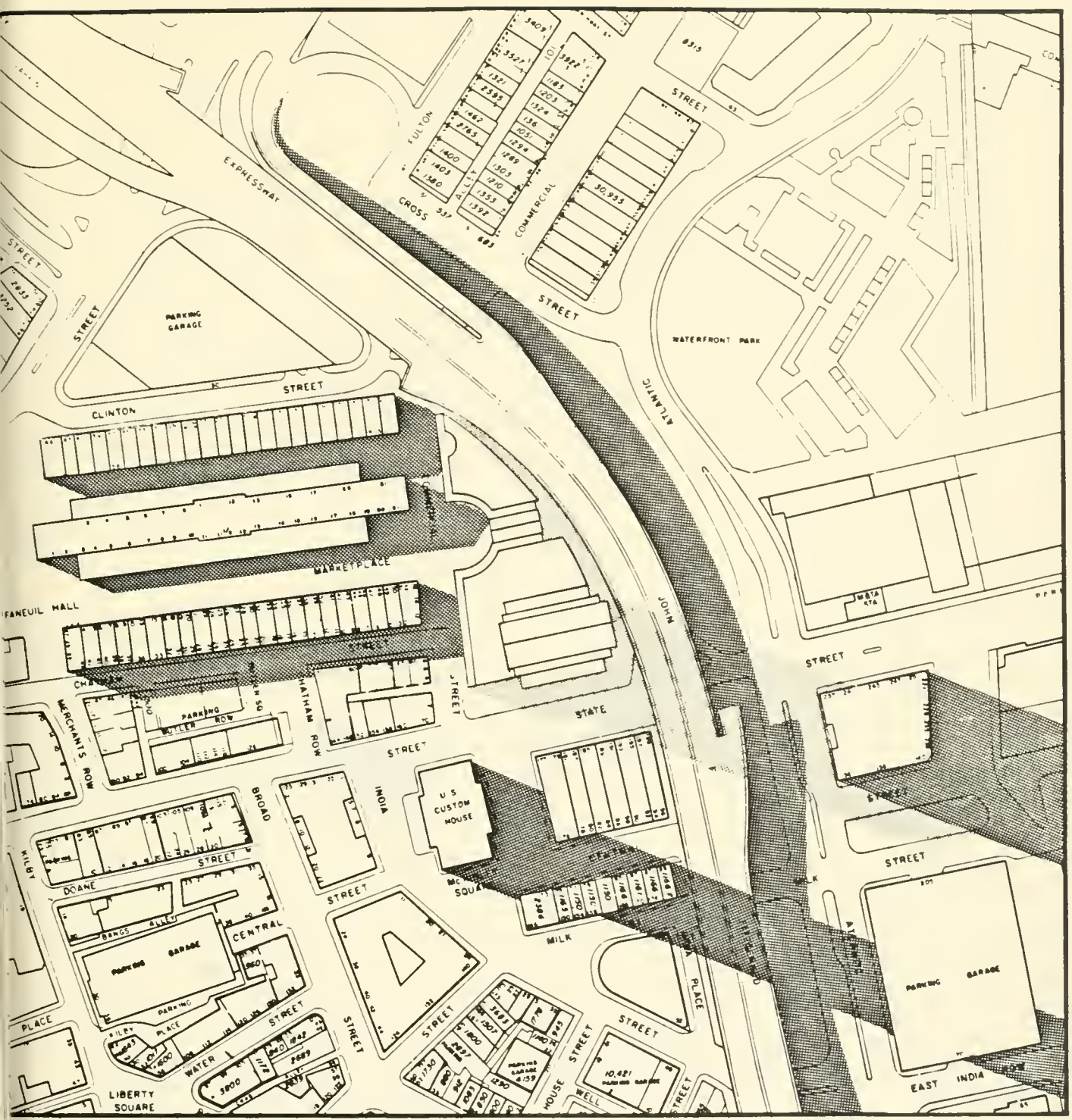
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: MARCH 21/ TIME 2:00 PM
SEPT. 23



MARKETPLACE CENTER

OSTON MA

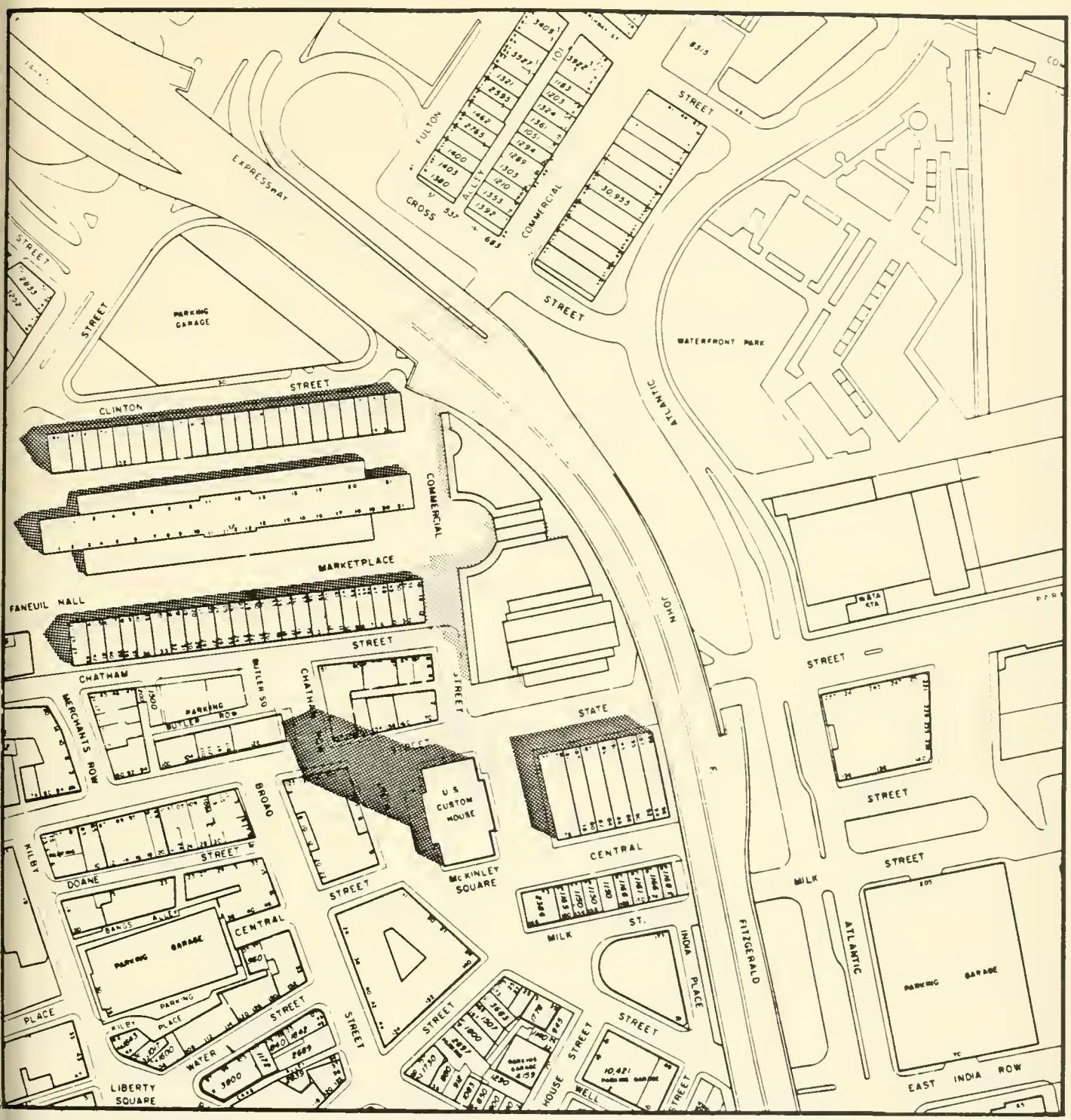
HADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: MARCH 21/ SEPT. 23 TIME: 4:00 PM



MARKETPLACE CENTER

BOSTON MA

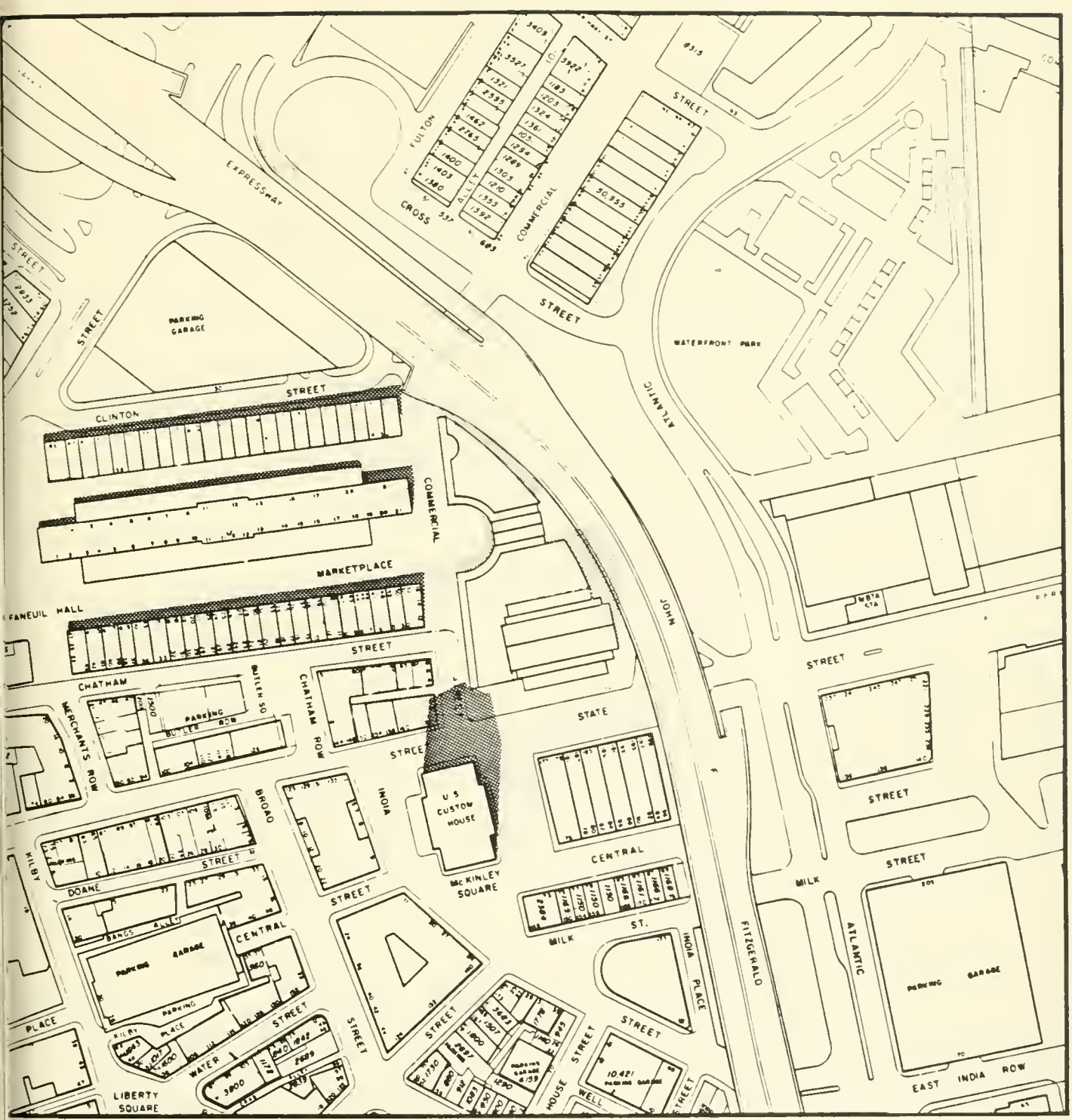
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: JUNE 22 TIME 10:00 AM



MARKETPLACE CENTER

BOSTON MA

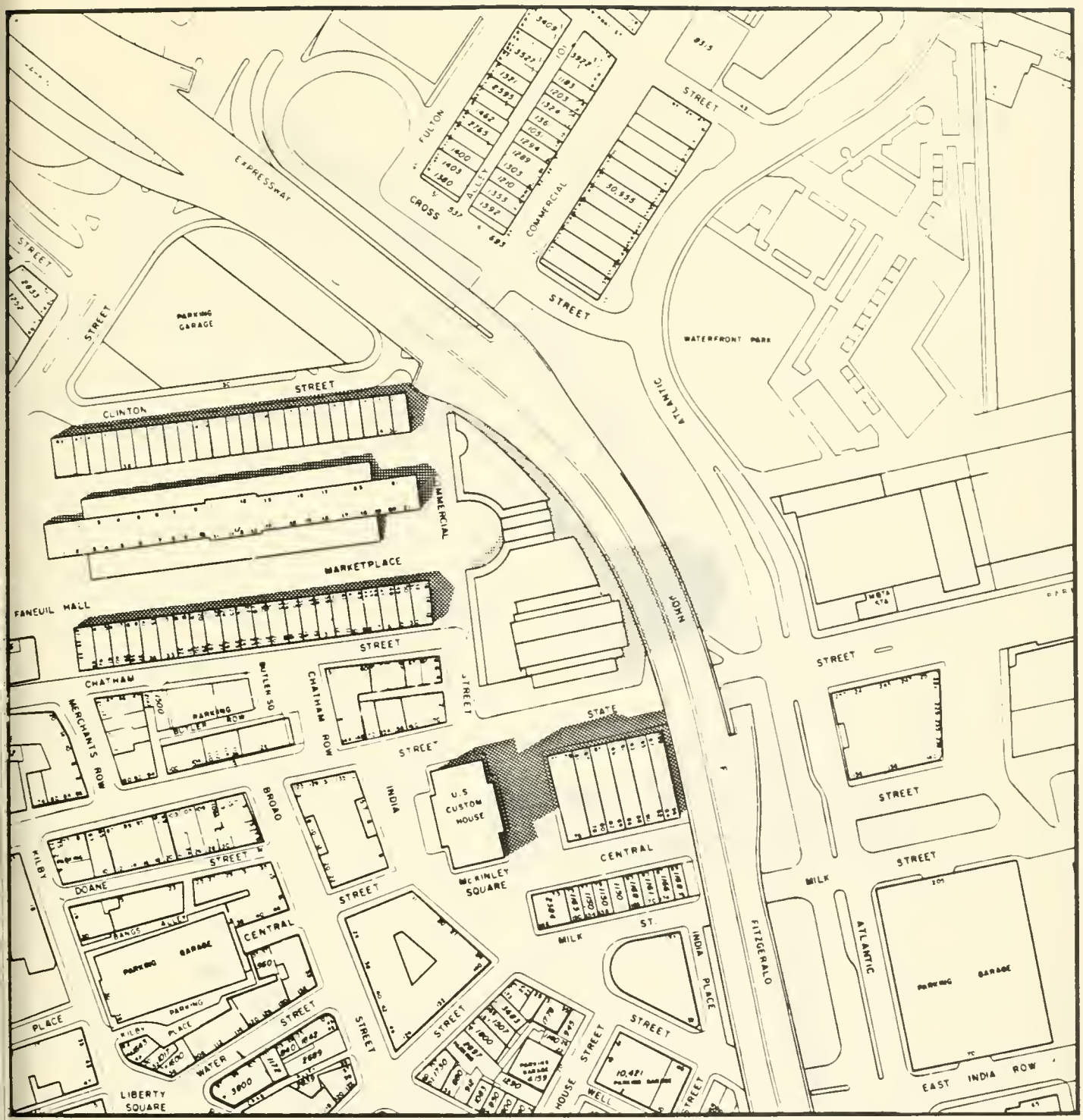
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: JUNE 22 TIME: 12:00 AM



MARKETPLACE CENTER

BOSTON MA

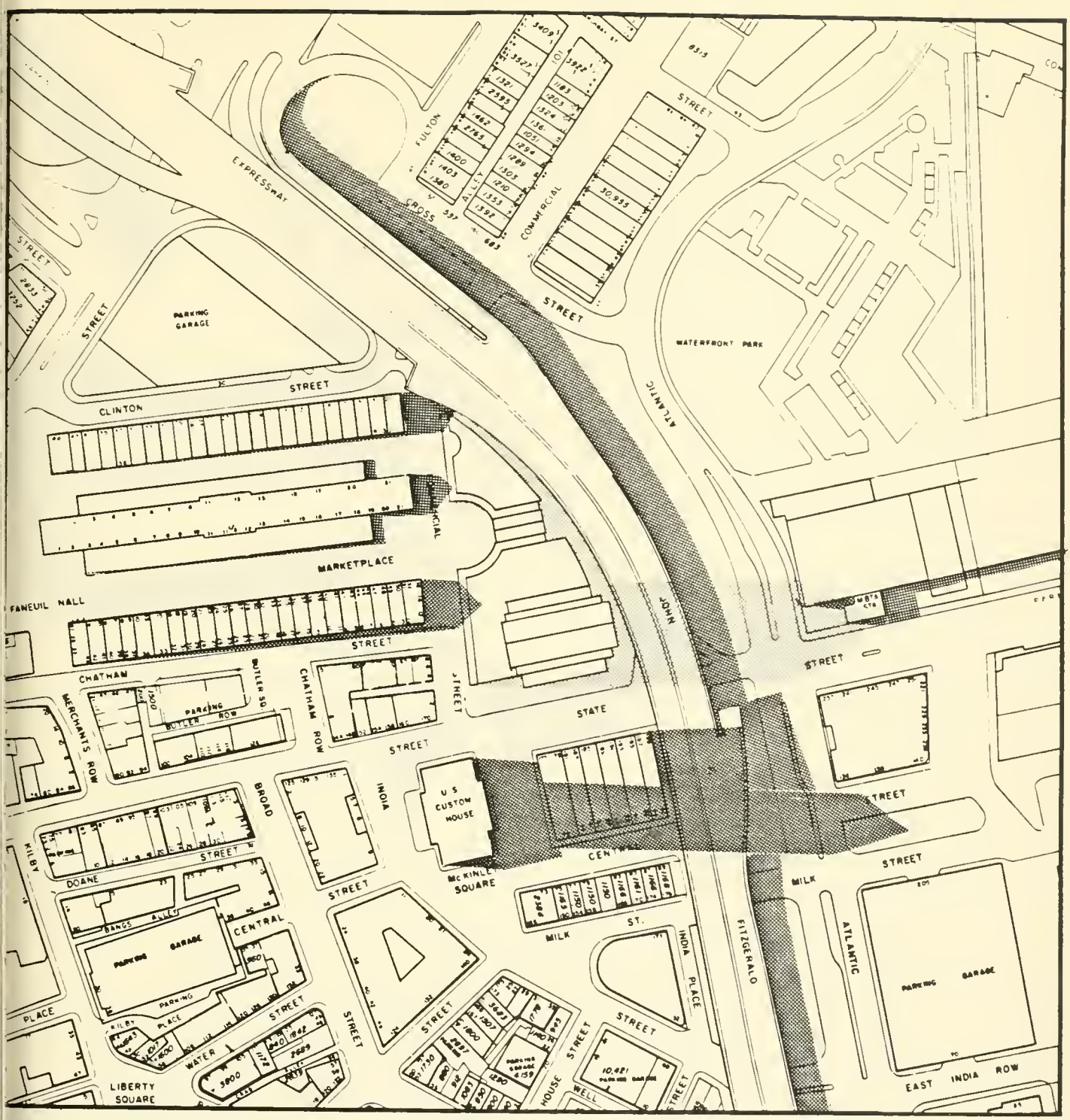
SHADOW STUDY

1 50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: JUNE 22 TIME 2:00 PM



MARKETPLACE CENTER

BOSTON MA

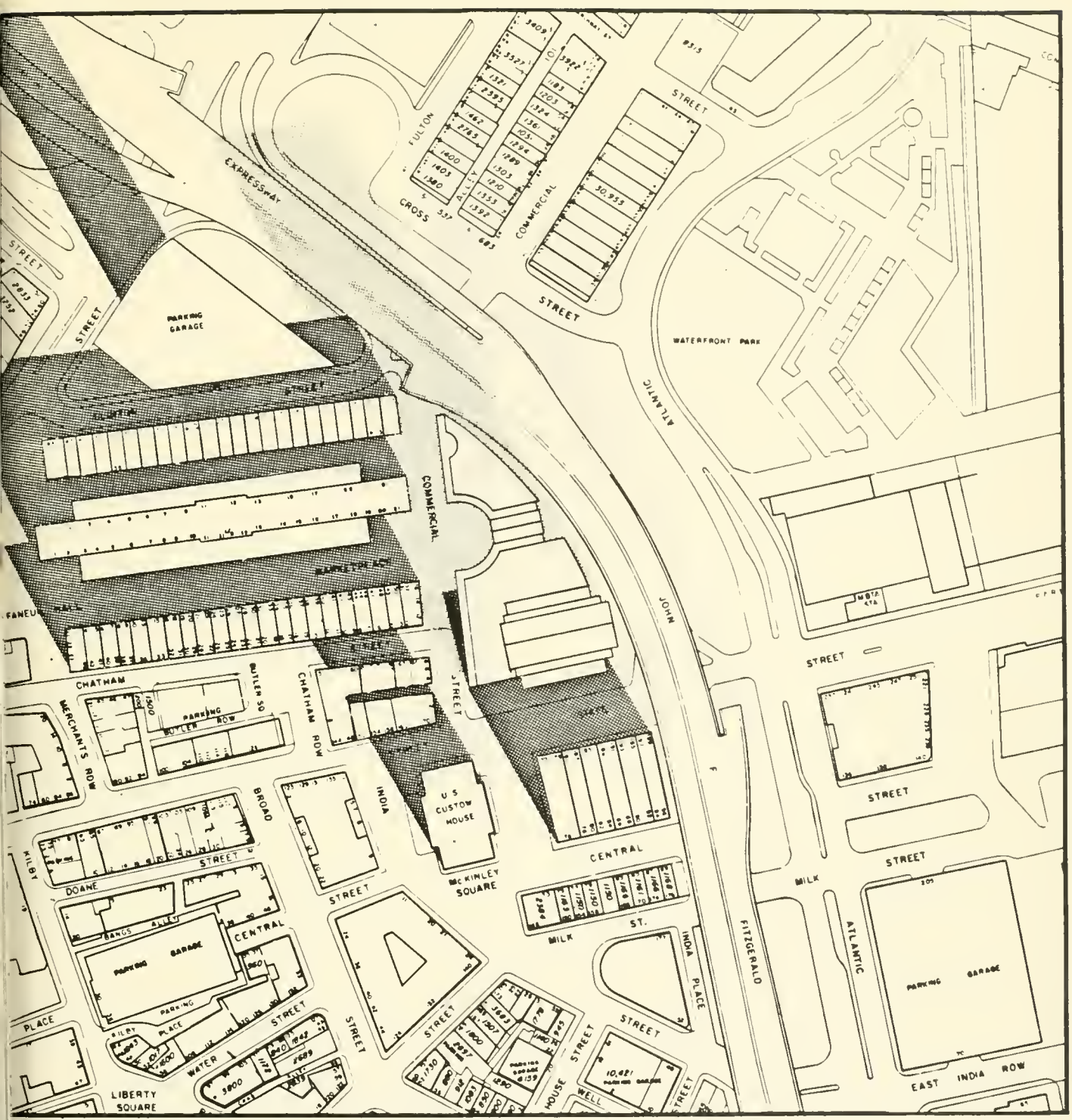
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE JUNE 22 TIME 4:00 PM



MARKETPLACE CENTER

BOSTON MA

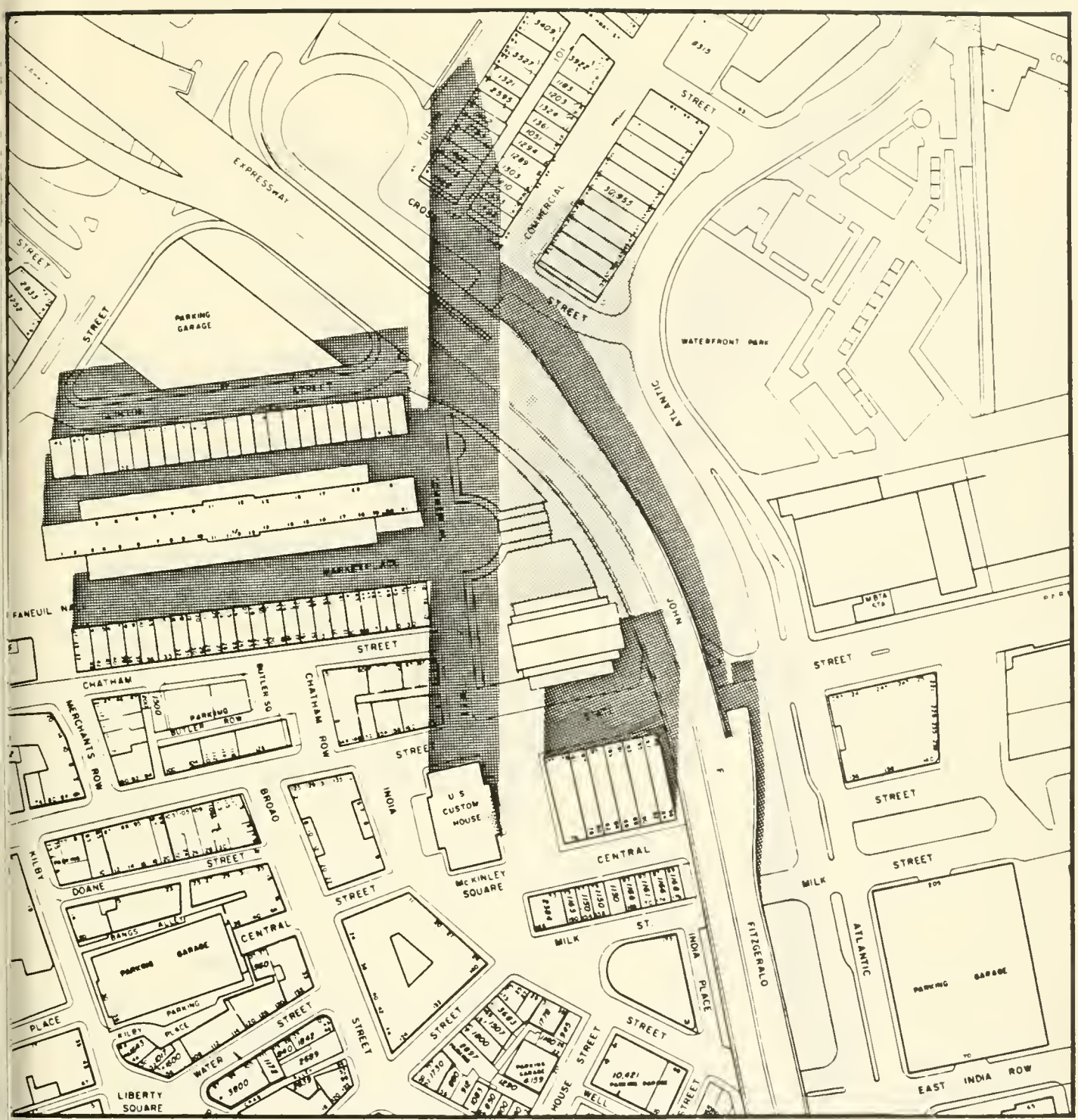
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: DEC. 22 TIME: 10:00 AM



MARKETPLACE CENTER

BOSTON MA

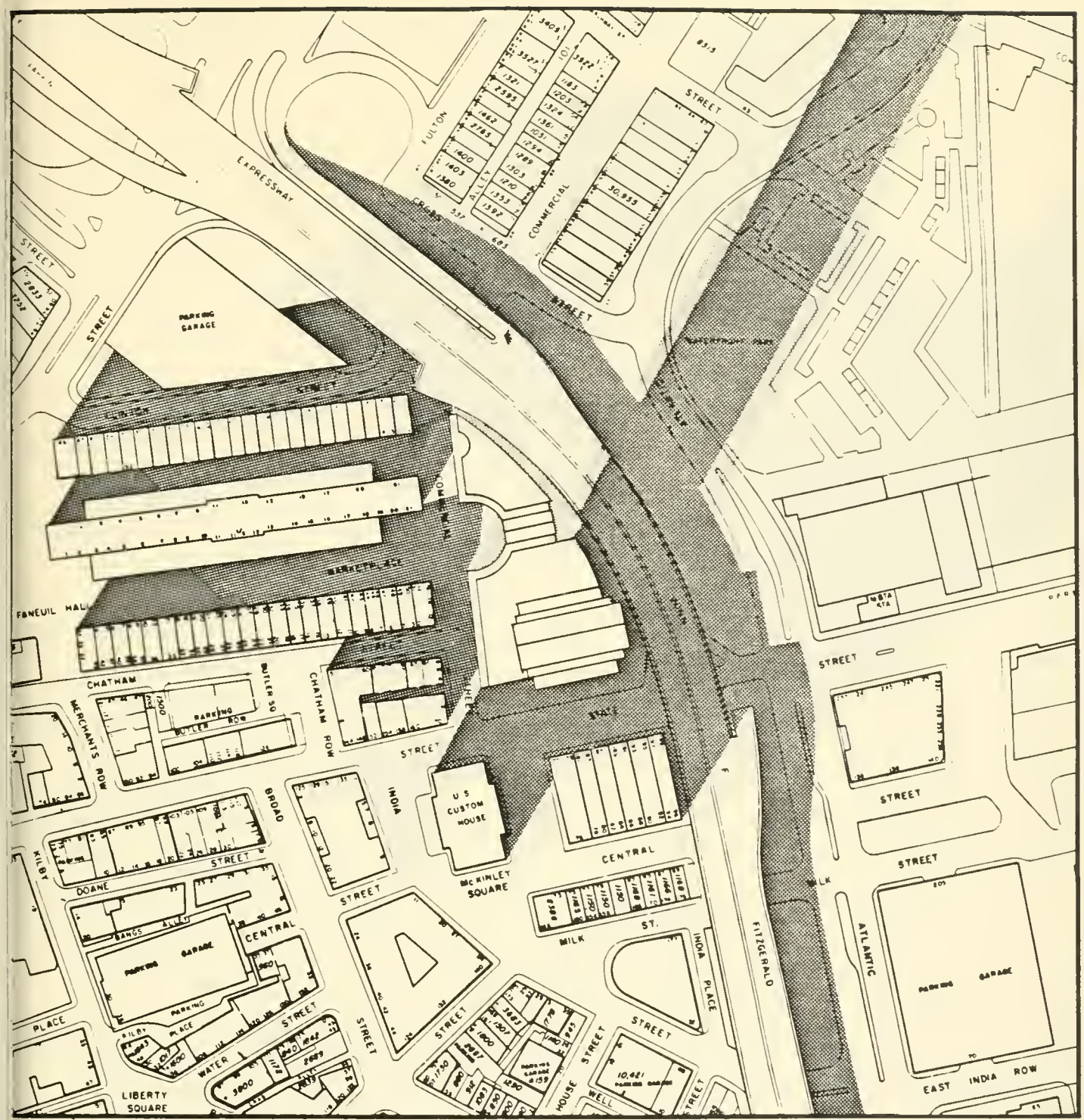
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE DECEMBER 22 TIME 12:00 AM



MARKETPLACE CENTER

BOSTON MA

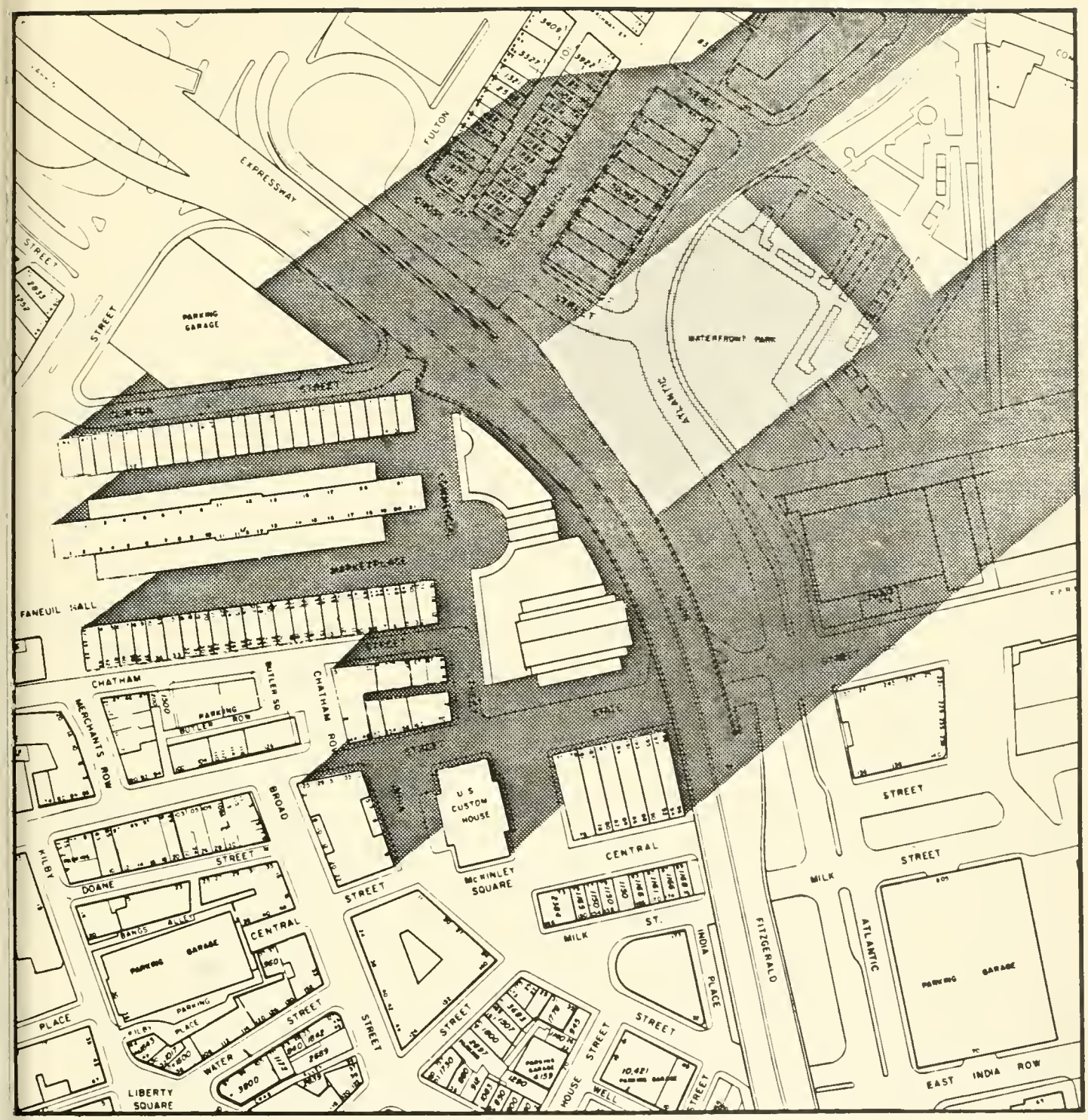
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: DEC. 22 TIME 2:00 PM



MARKETPLACE CENTER

BOSTON MA

SHADOW STUDY

SHADOWS UNDER EXISTING CONDITIONS

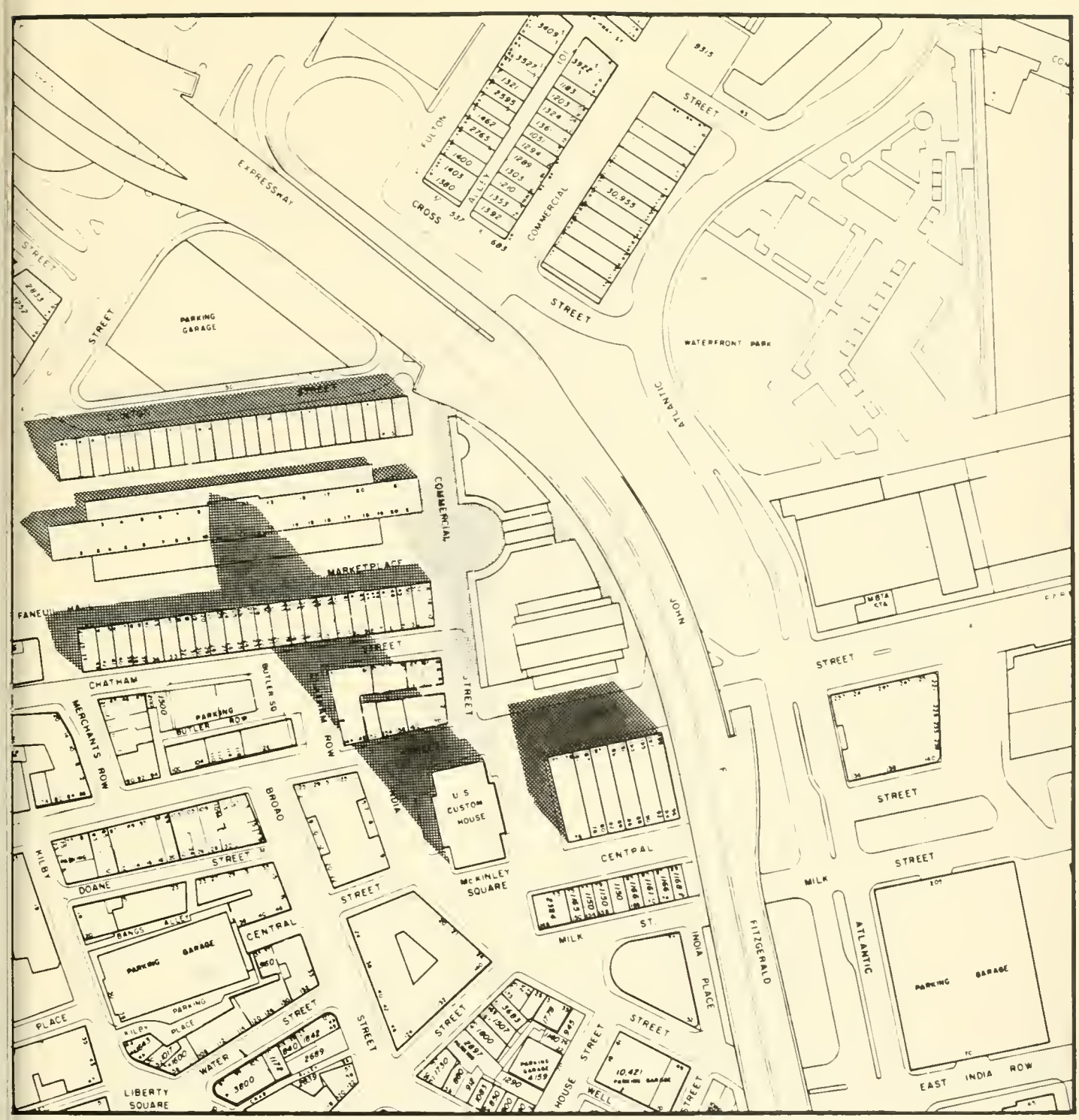
ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE DECEMBER 22 TIME 4:00 PM

0 50 100 200 300 400

SHADOWS FOR CURRENT

220 FT. BUILDING



MARKETPLACE CENTER

BOSTON MA

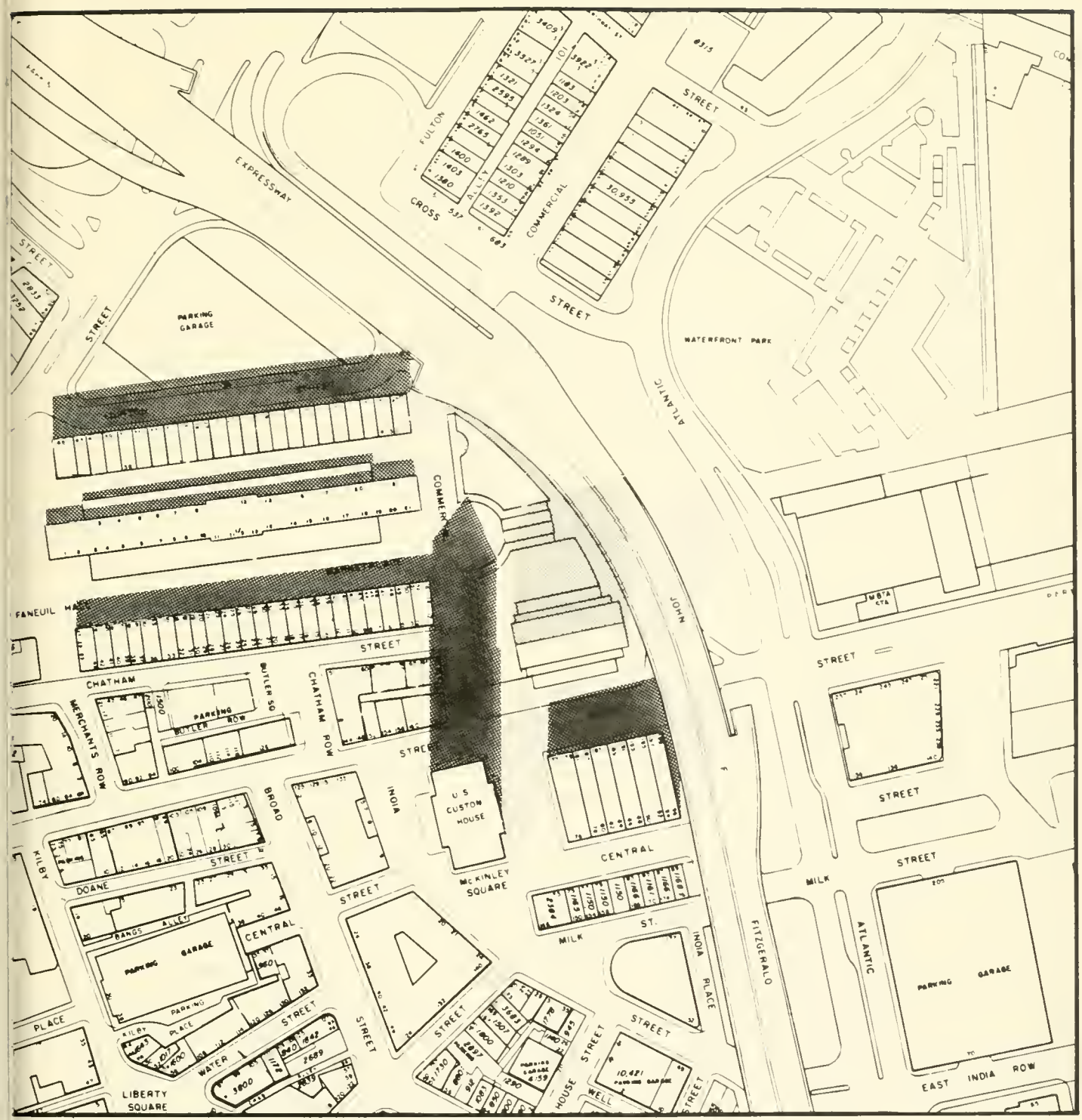
SHADOW STUDY

0 50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: MARCH 21/ SEPT. 23 TIME 10:00 AM



MARKETPLACE CENTER

BOSTON MA

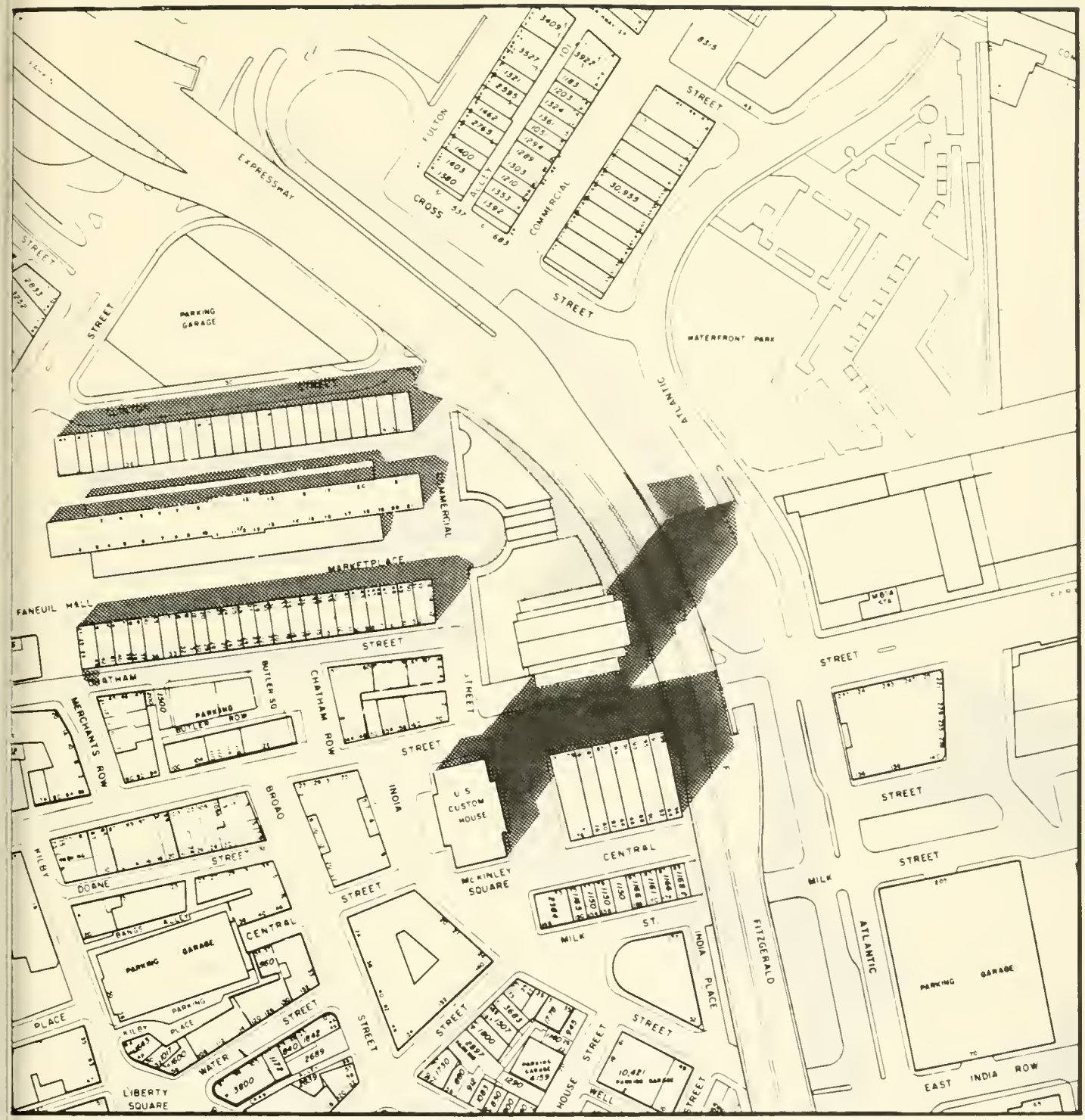
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: MARCH 21/ SEPT. 23 TIME: 12:00 AM



MARKETPLACE CENTER

BOSTON MA

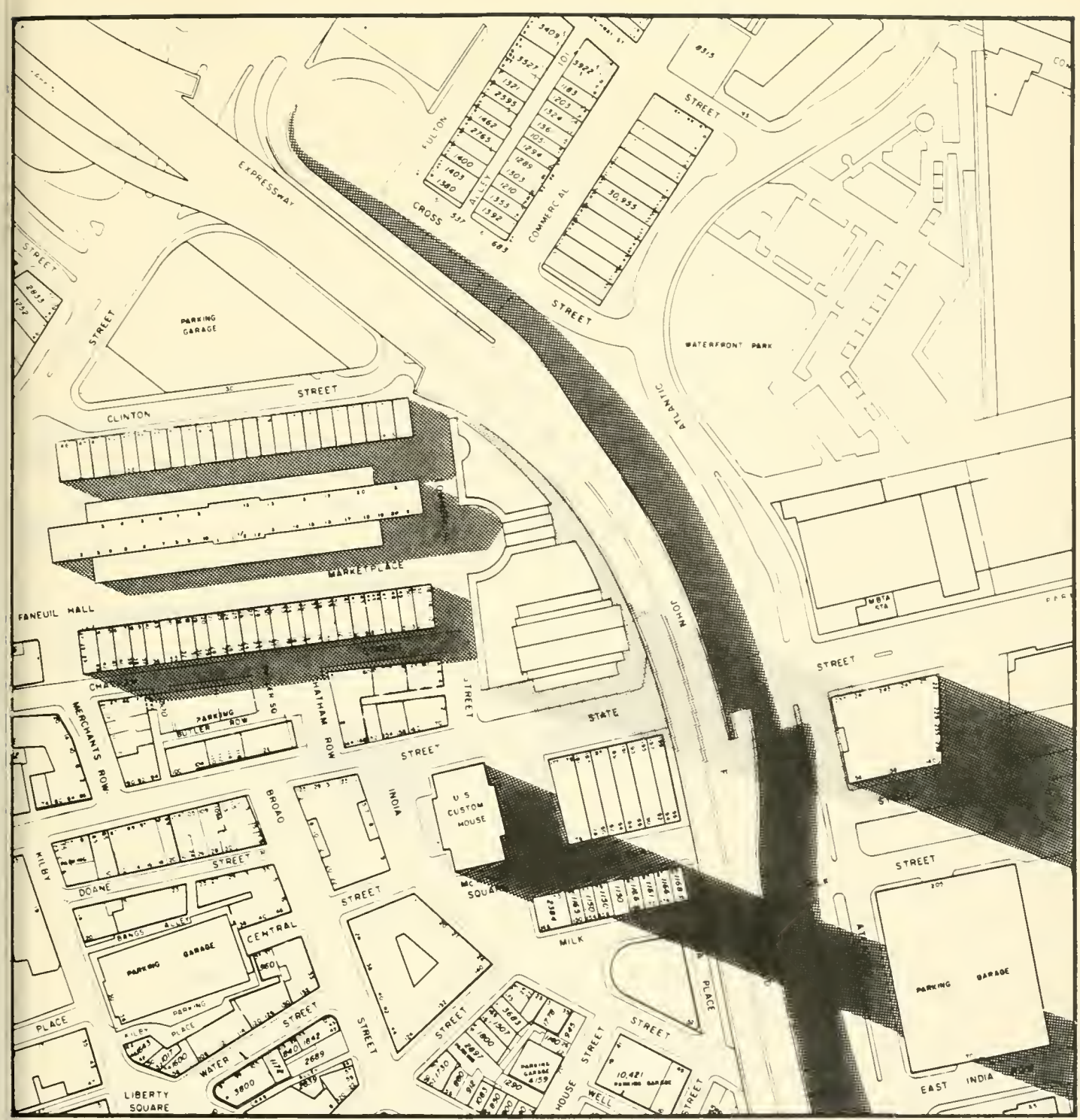
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE MARCH 21/ SEPT. 23 TIME 2:00 PM



MARKETPLACE CENTER

BOSTON MA

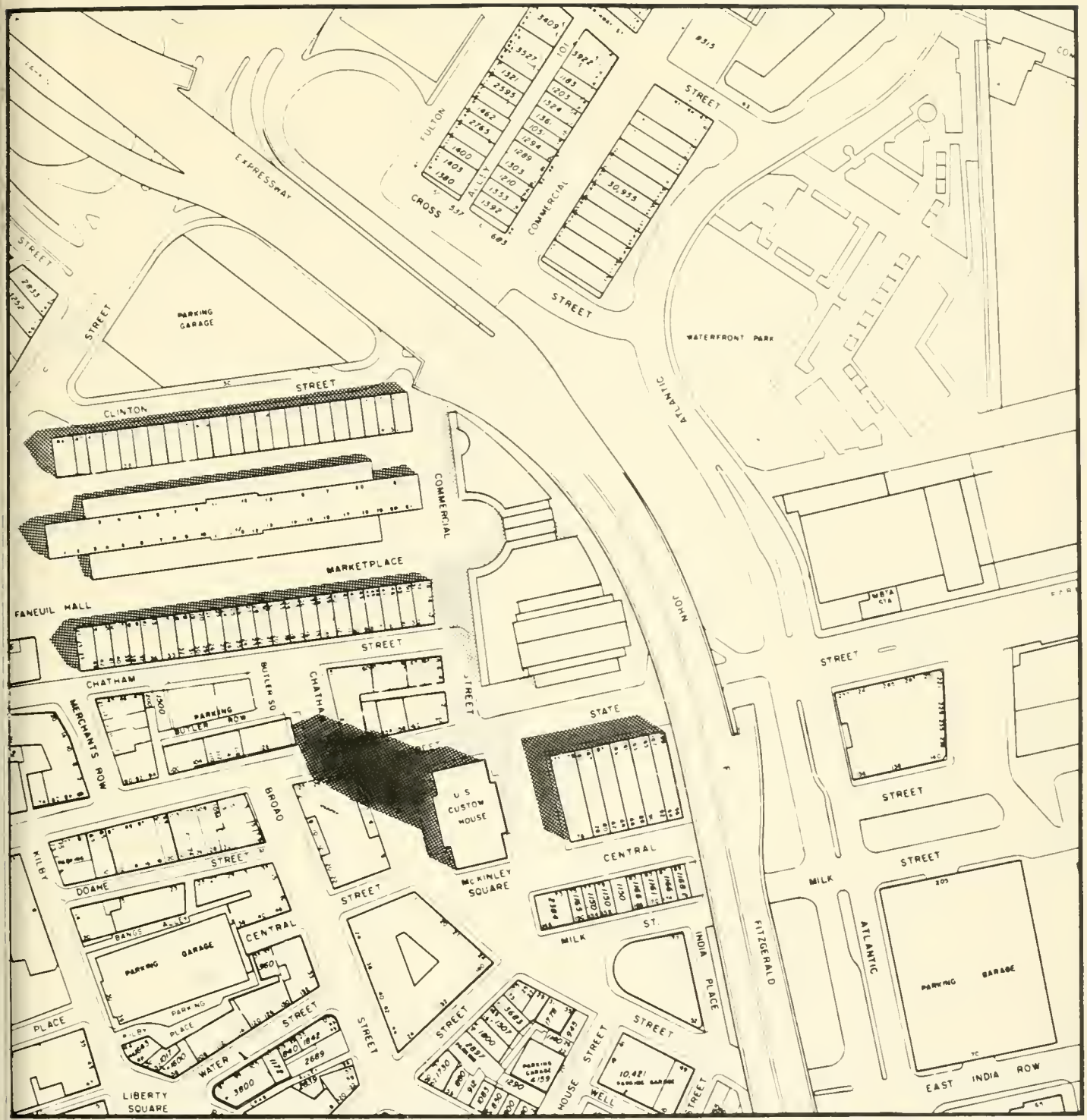
SHADOW STUDY

0 50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: MARCH 21/ SEPT. 23 TIME 4:00 PM



MARKETPLACE CENTER

BOSTON MA

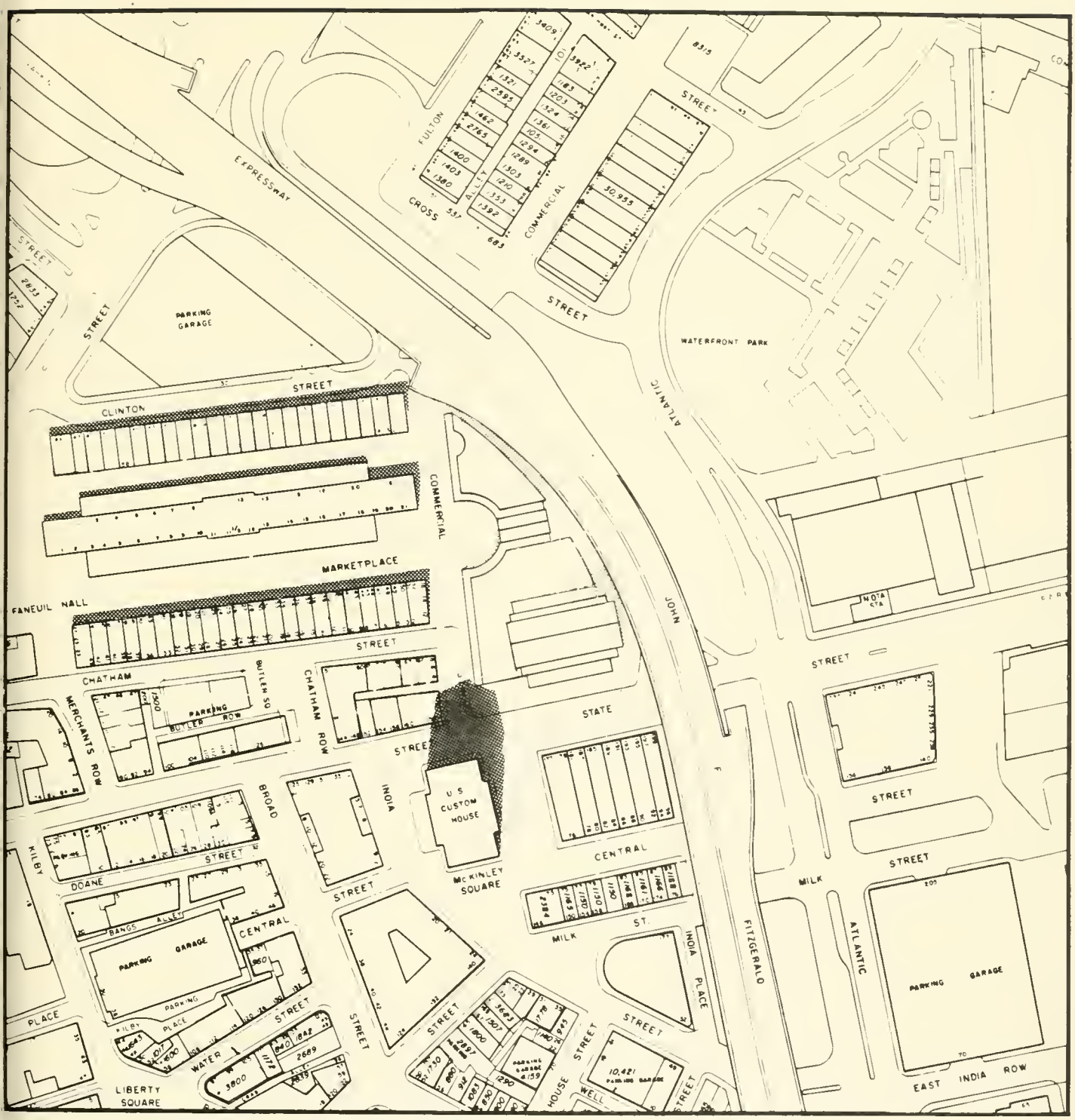
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: JUNE 22 TIME: 10:00 AM



MARKETPLACE CENTER

BOSTON MA

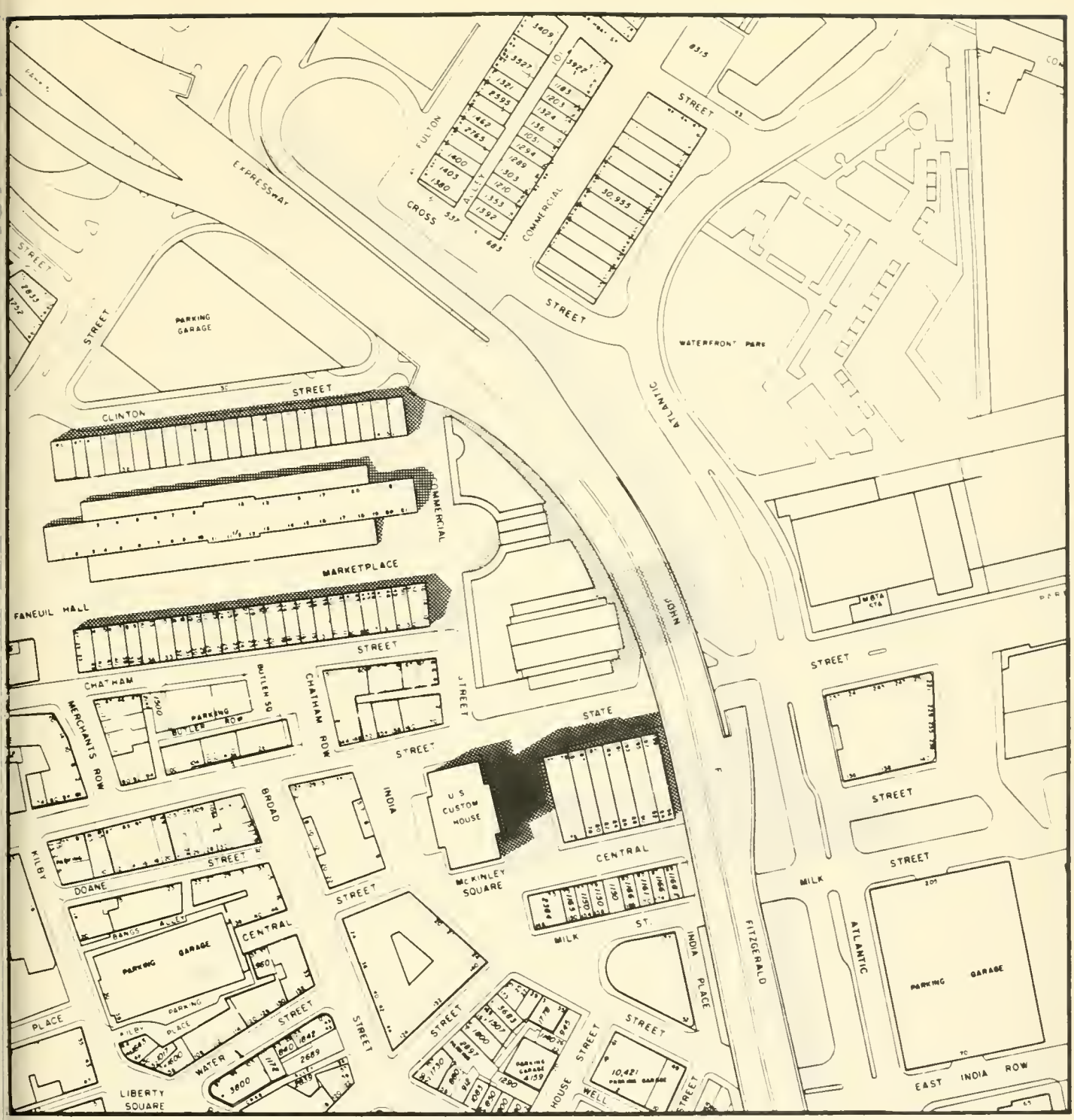
SHADOW STUDY

0 50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: JUNE 22 TIME: 12:00 A.M.



MARKETPLACE CENTER

BOSTON MA

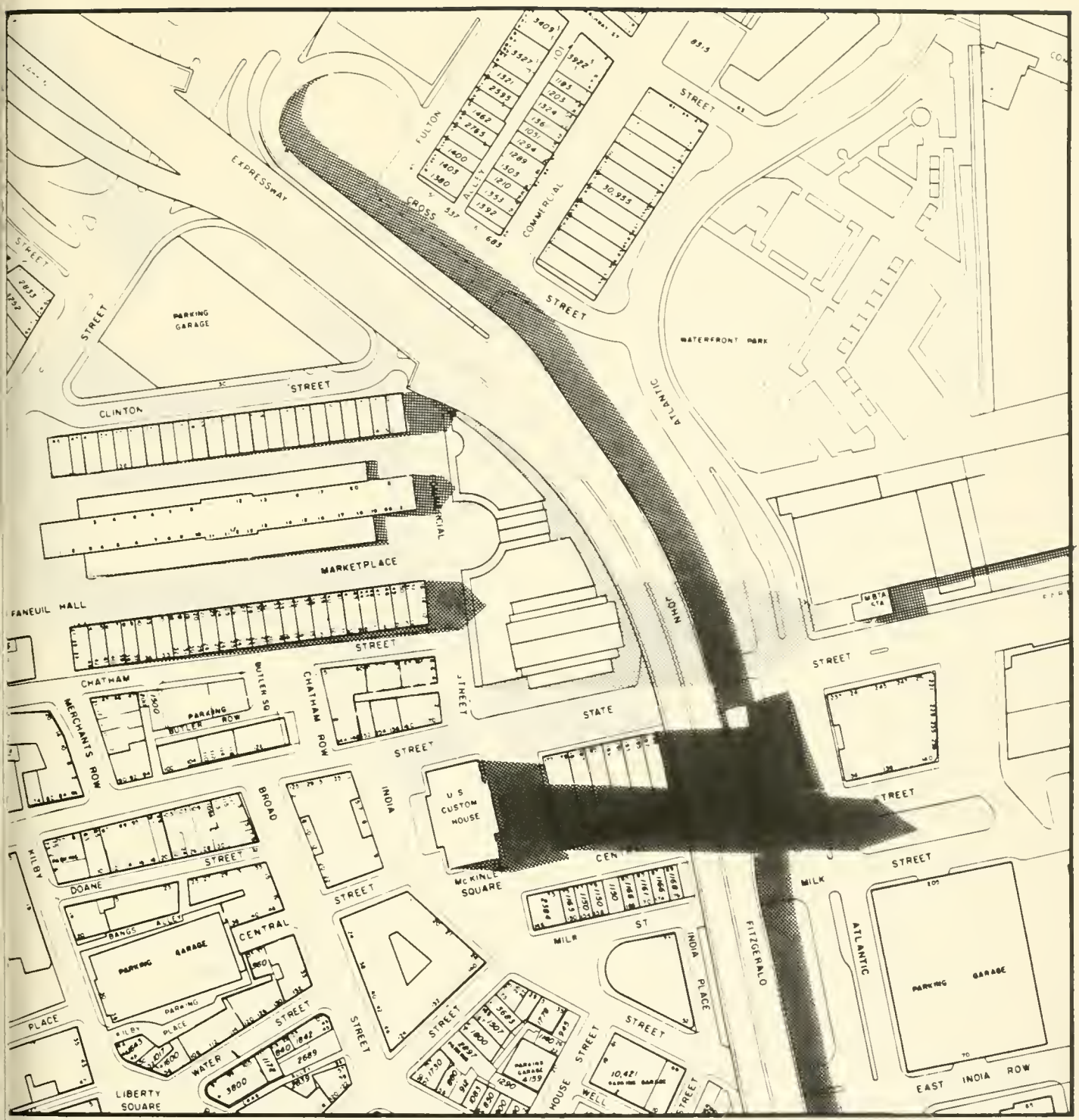
SHADOW STUDY

0 50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: JUNE 22 TIME: 2:00 PM



MARKETPLACE CENTER

BOSTON MA

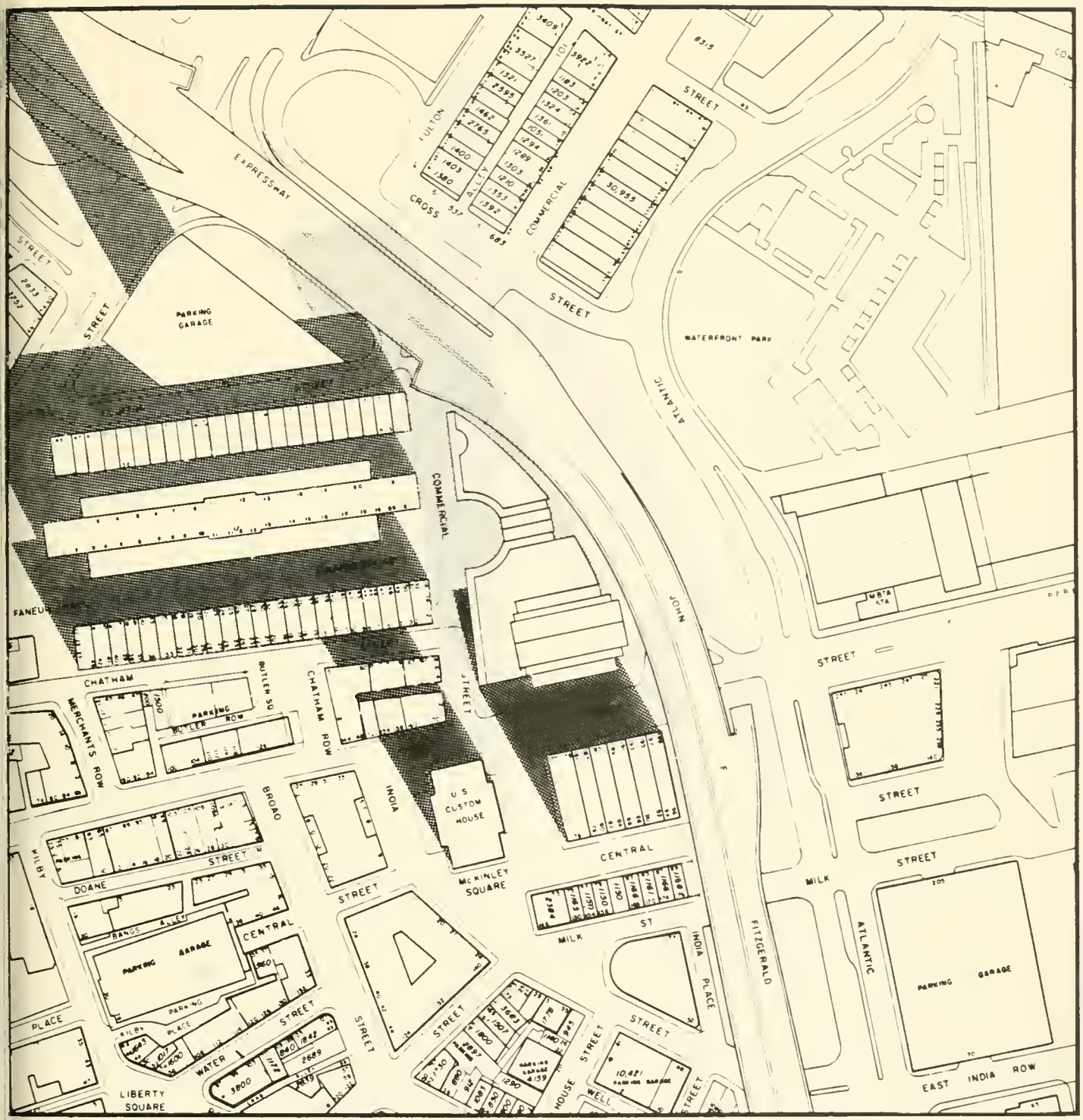
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: JUNE 22 TIME 4:00 PM



MARKETPLACE CENTER

BOSTON MA

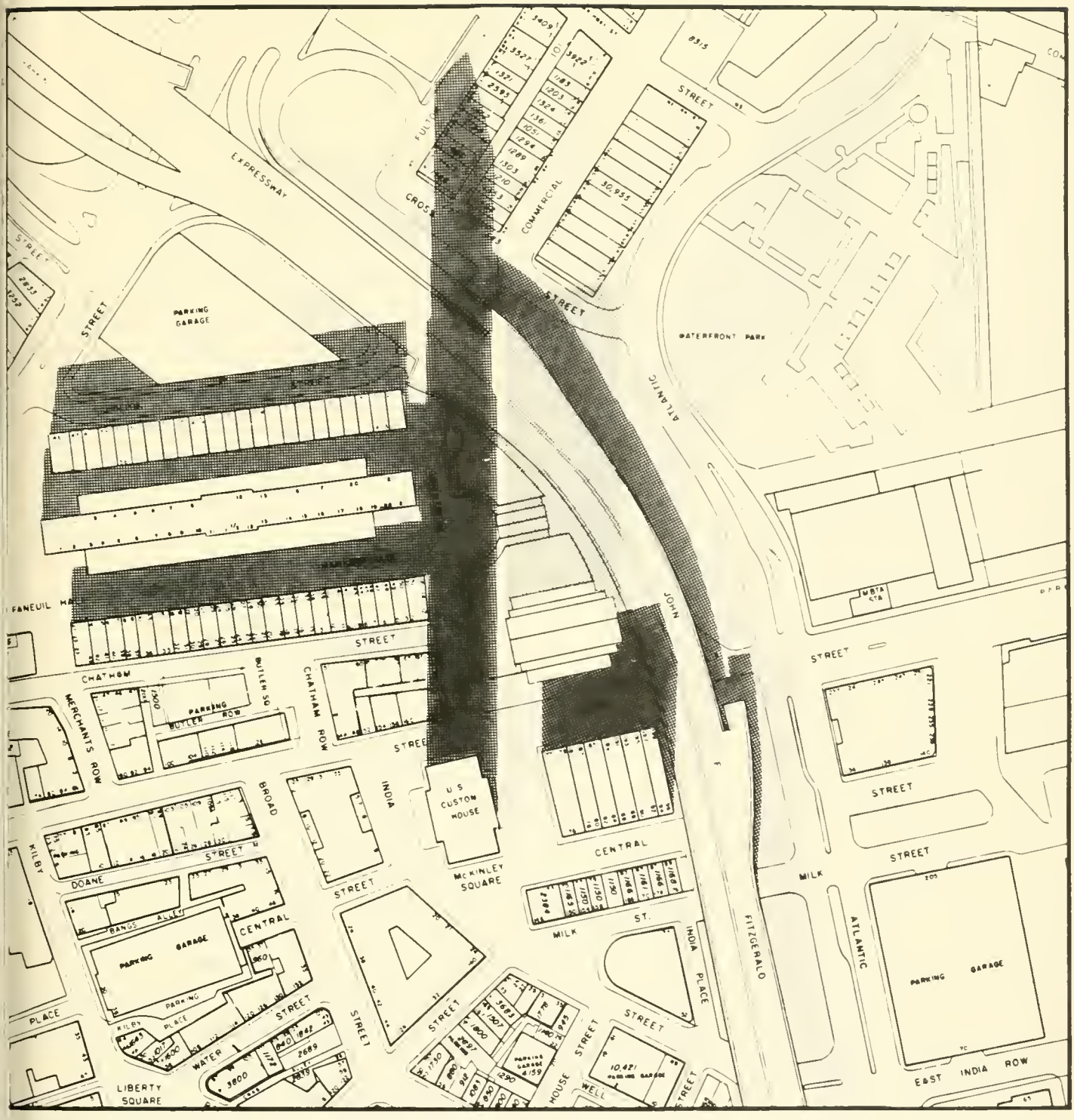
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE DEC. 22 TIME: 10:00 AM



MARKETPLACE CENTER

BOSTON MA

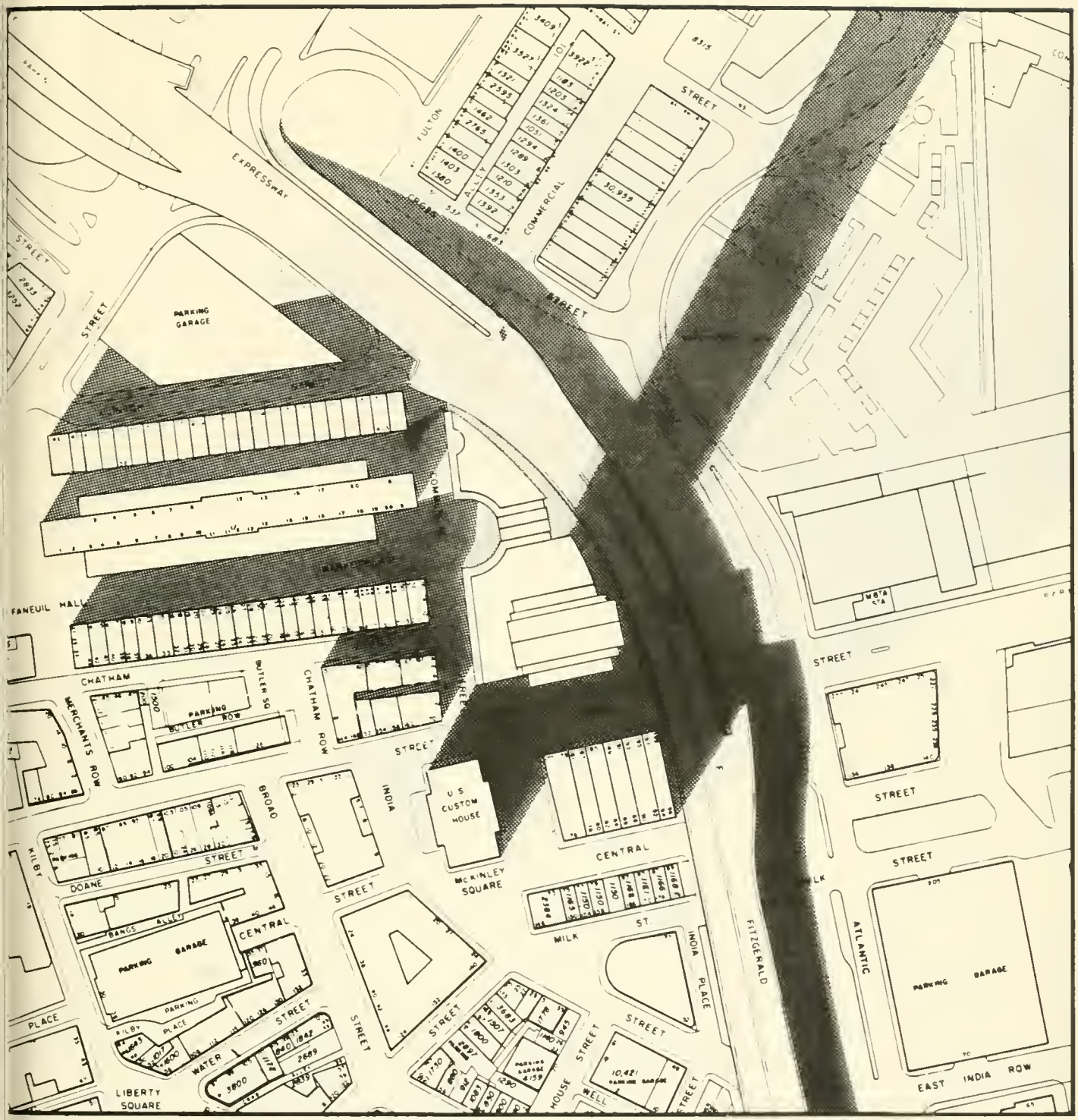
SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE: DECEMBER 22 TIME: 12:00 AM



MARKETPLACE CENTER

BOSTON MA

SHADOW STUDY

50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE DEC. 22 TIME 2:00 PM

MARKETPLACE CENTER

BOSTON MA

SHADOW STUDY

0 50 100 200 300 400

SHADOWS UNDER EXISTING CONDITIONS

ADDITIONAL SHADOWS DUE TO MARKETPLACE CENTER

DATE DECEMBER 22 TIME 4:00 PM

4. Visual Impacts

At best, the judgment of a building's visual impact is always subjective. However, it must be recognized that Marketplace Center is to be built on a BRA parcel which is widely recognized for its key location with regard to existing historic resources and its potential as a landmark for visitors to the City arriving via the Central Artery. For this reason, the BRA developer solicitation included stringent design criteria which were required of all developer submittals. Furthermore, the BRA's design review of Marketplace Center is an ongoing process which will continue until the approval of final working drawings and specifications, and on-site material samples.

Together with the BRA, the project's architects have also met with representatives of the Massachusetts Historical Commission and the Boston Landmarks Commission, and as a direct result of their input, the south-west corner of the building was moved southward to better define the "edge" of Historic State Street.

Following are some of the measures which have been taken during the design process to insure that the building is well integrated into its surroundings.

a. The three story base element is low enough to be compatible with the market buildings, yet high enough to visually mask the Central Artery from the pedestrian environment.

b. The office element is set back from Commercial Street to allow better views of the Custom House Tower from the "Walk-to-the-Sea".

c. Rather than being a simple rectangle in plan, the office building has stepped corners - an architectural technique to visually reduce the bulk of a building.

d. The top of the office building has a pitched roof so that, in urban design terms, the long axis of the building relates to the Faneuil Hall Markets and the Long Wharf Hotel. This emphasizes the linearity and continuity of the "Walk-to-the-Sea".

e. The building will be predominantly granite to match or complement the surrounding granite buildings.

f. All pedestrian areas will be paved in brick and granite with treatments designed by William Pressley and Associates, the same Landscape Architect who designed the Faneuil Hall Markets. Through the visual flow of paving, lighting, landscaping and street furniture, it is intended that there will be no noticable boundary between Marketplace Center and the Faneuil Hall Markets.

The single most important change in the building throughout the

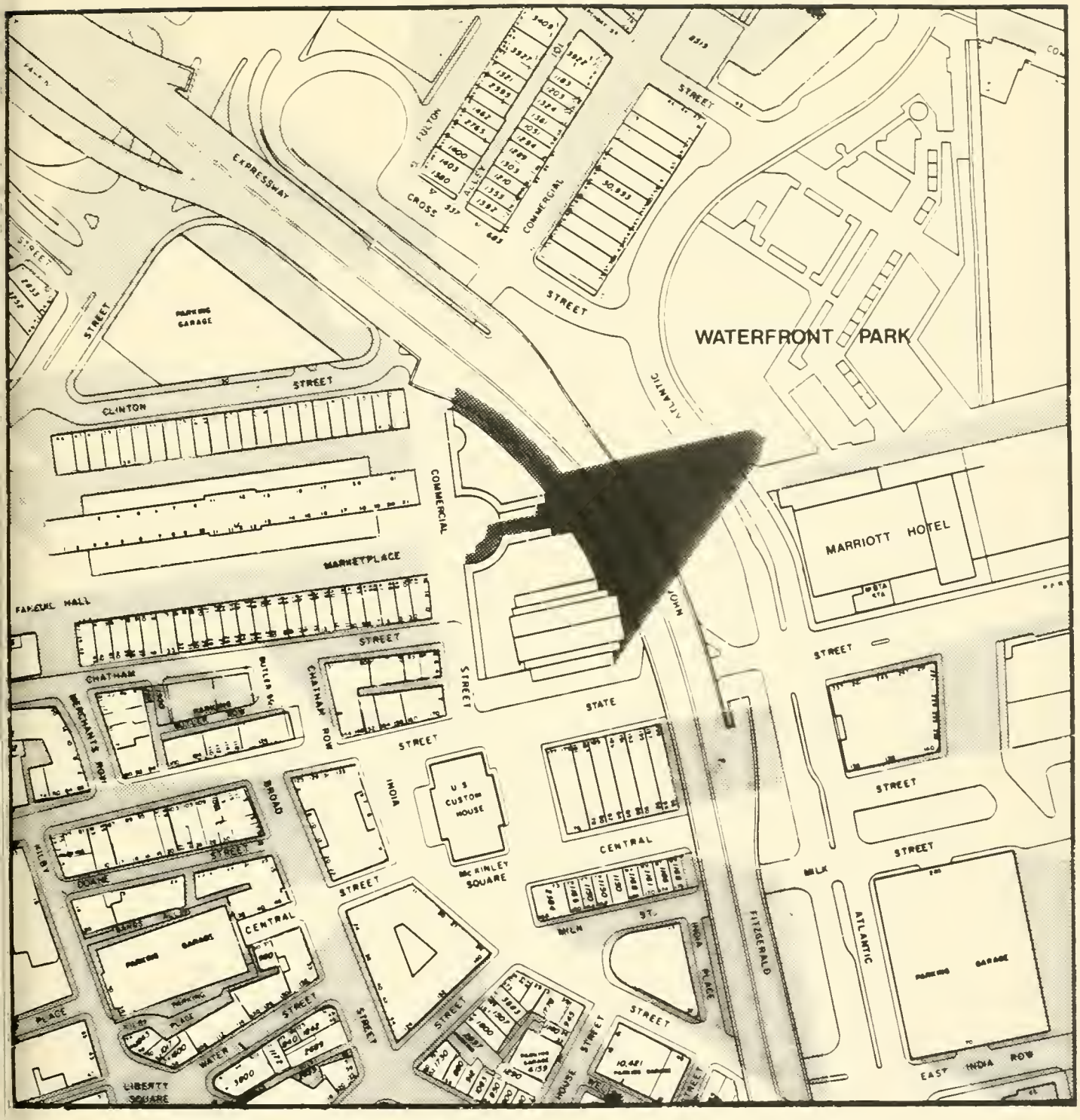
design review and MEPA processes, has been the height. After carefully studying the building at the 280 foot height, the decision was made to remove 5 complete office floors so that the height is now 220 feet. Because the office element was moved back from State Street, this means that the bulk of the building is now significantly less than that originally submitted to the BRA.

Following is a table which shows how the project has evolved during the design review process and the MEPA Environmental review. The architect, WZMH Group Inc. has reviewed the design at various stages with representatives of the following:

1. Boston Redevelopment Authority
2. MEPA Unit Staff
3. Massachusetts Historical Commission
4. Boston Landmarks Commission
5. Massachusetts Coastal Zone Management
6. Boston Society of Architects
7. Preservation Alliance
8. Faneuil Hall Markets Inc.
9. Sierra Club

URBAN DESIGN CHRONOLOGY

	Height	Office Floors	F.A.R.	Typical Office Floor	Approximate Gross Area
1. Original submission to B.R.A. and basis of E.N.F.	220 Ft.	16	5.8	25,000 Sq. Ft.	506,000 Sq. Ft.
2. Early design review-office element moved away from Commercial Street-- submission of Draft E.I.R.	284 Ft.	21	6.0	20,055 Sq. Ft.	543,000 Sq. Ft.
3. Continued design review-base moved out to State Street at request of Mass. Historical Comm. and Boston Landmarks Commission-submission of supplement to draft E.I.R.	284 Ft.	21	6+	20,055 Sq. Ft.	549,000 Sq. Ft.
4. Final B.R.A. design approval and submission of final E.I.R.	220 Ft.	16	5.25	20,055 Sq. Ft.	447,000 Sq. Ft.



MARKETPLACE CENTER

BOSTON MA

VISUAL IMPACT STUDY

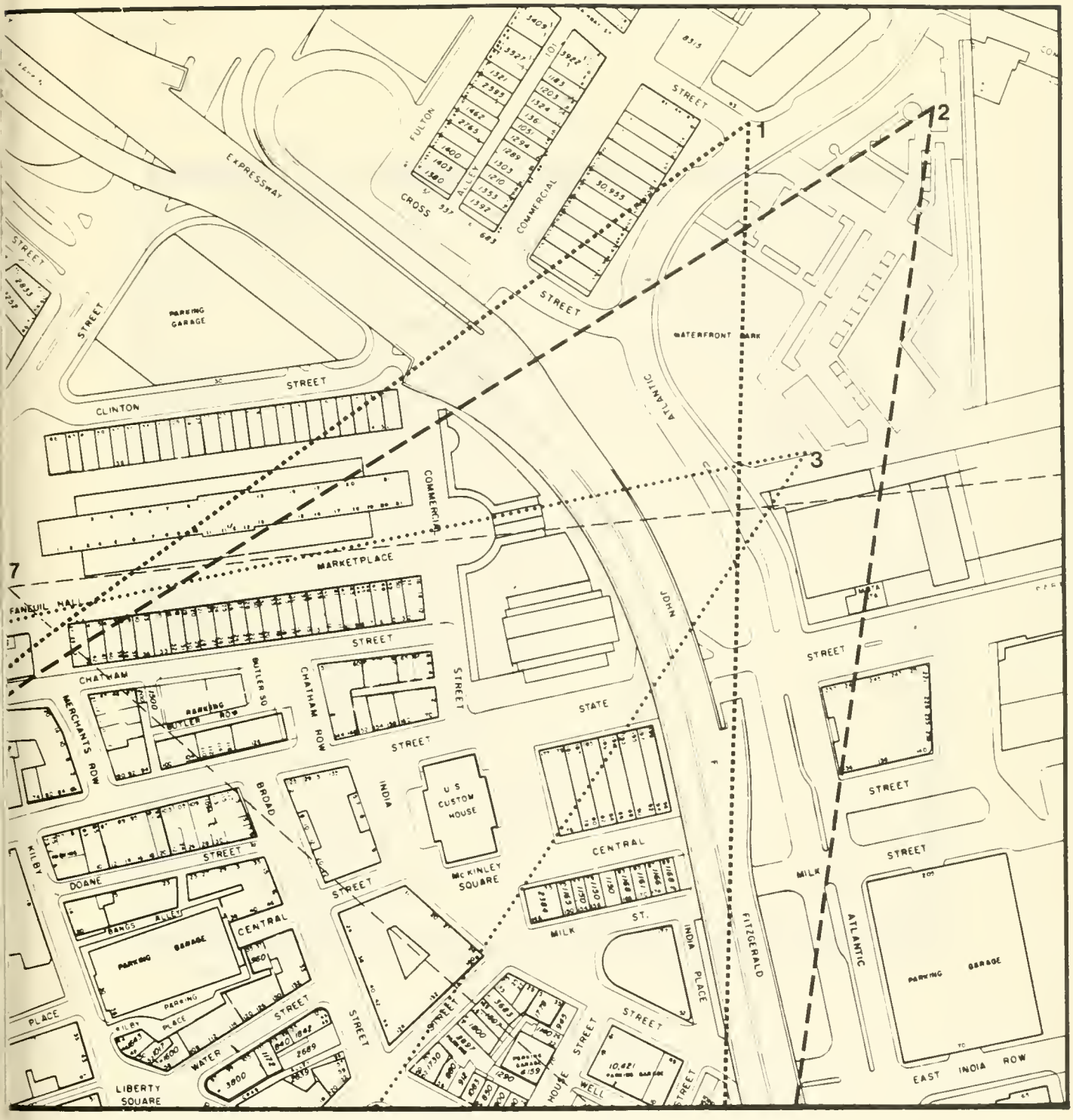
SUBJECT BUILDING:

Custom House

EXISTING AREA OF TOTAL VISUAL OBSTRUCTION

ADDED AREA OF TOTAL VISUAL OBSTRUCTION

0 50 100 200 300 400

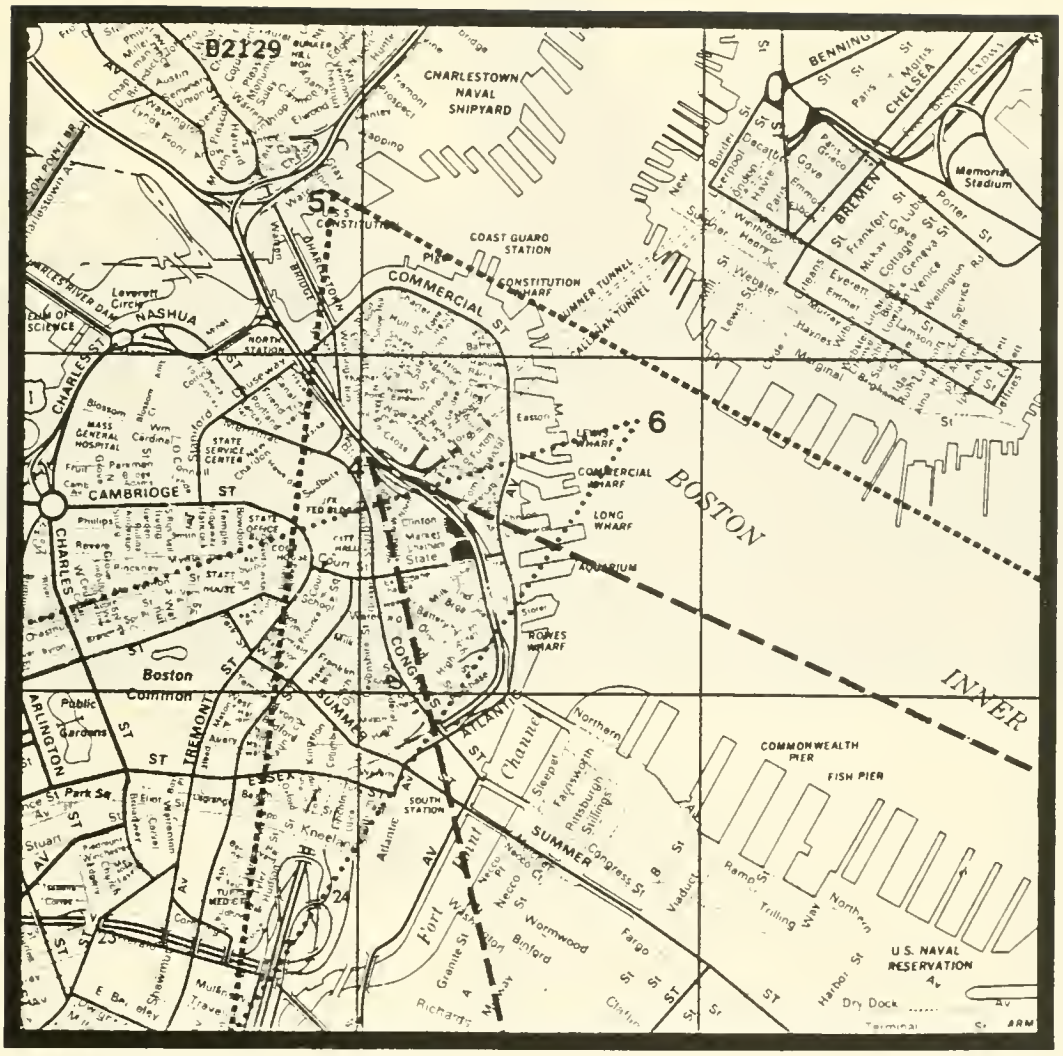


MARKETPLACE CENTER

BOSTON MA

SMALL SCALE KEY PLAN

0 50 100 200 300 400


B2129
CHARLESTOWN NAVAL SHIPYARD
COAST GUARD STATION
CONSTITUTION WHARF
COMMERCIAL ST
SUMNER TUNNEL
CALLAHAN TUNNEL
BENNINGTON ST
CHELSEA
BREMEN ST
Memorial Stadium
NASHUA
CHARLES RIVER DAM
MUSEUM OF SCIENCE
NORTH STATION
MASS GENERAL HOSPITAL
STATE SERVICE CENTER
CAMBRIDGE ST
CHARLES ST
Boston Common
Public Gardens
ARLINGTON ST
TREMONT ST
SOUTH STATION
Easton
LEWIS WHARF
COMMERCIAL WHARF
LONG WHARF
AQUARIUM
ROWES WHARF
BOSTON
INNER
ATLANTIC AV
Northern Channel
COMMONWEALTH PIER
FISH PIER
SUMMER ST
Congress St
Viaduct
Trilling Way
Ramp
U.S. NAVAL RESERVATION
Harbor St
Dry Dock
Terminal
Fort Point Channel
Wormwood
Binford
Fargo
Granite St
Richards
Chestnut
Kneeland
Atlantic Av
Stuart St
E Berkeley
Park Sq
Shawmut
Traveler
Mulberry
Necco St
Necco Pl
Sleeper
Fairweather
Pittsburgh
Stillings
Northern
Porter St
Paris St
Mystic
Boston Edison
Grove
Emmet
Frankfort
Cottage
Geneva
Venice
Wellington Rd
Everett
Orleans
Lexington
Liverpool
Decatur
Bunker Hill Monument
Bunker Hill Mon
Lovejoy Circle
Lovejoy Wharf
Haynes
Webster
Lewis
Hull
Baker
Blossom
Wm Cardinal
Stanford
Phillips
Revere
Beacon
Princeton
Bowdoin
Hancock
Joy
Mt Vernon
Chestnut
Pinckney
Temple
Somerset
Ashburton
Park
Tyler
Allen
Oak
Utica
Myrtle
Hanover
Prince
Salem
Endicott
Snowhill
Commercial
Clinton
Market
Faneuil Hall
City Hall
Court
State
Dock
Milk
Broad
Franklin
Federal
Post Office
Sq
Summer
Kingston
Bedford
Essex
Lincoln
Chauncy
Avery
Eliot
Boylston
Piedmont
Church
Warrenton
Berkeley
Clarendon
Dartmouth
Exeter
Fairfield
Gloucester
Hereford
Hemenway
Massachusetts
Westland
Huntington
Belvidere
Gainsborough
Worcester
Newbury
Marlborough
Commonwealth
Beacon
Arlington

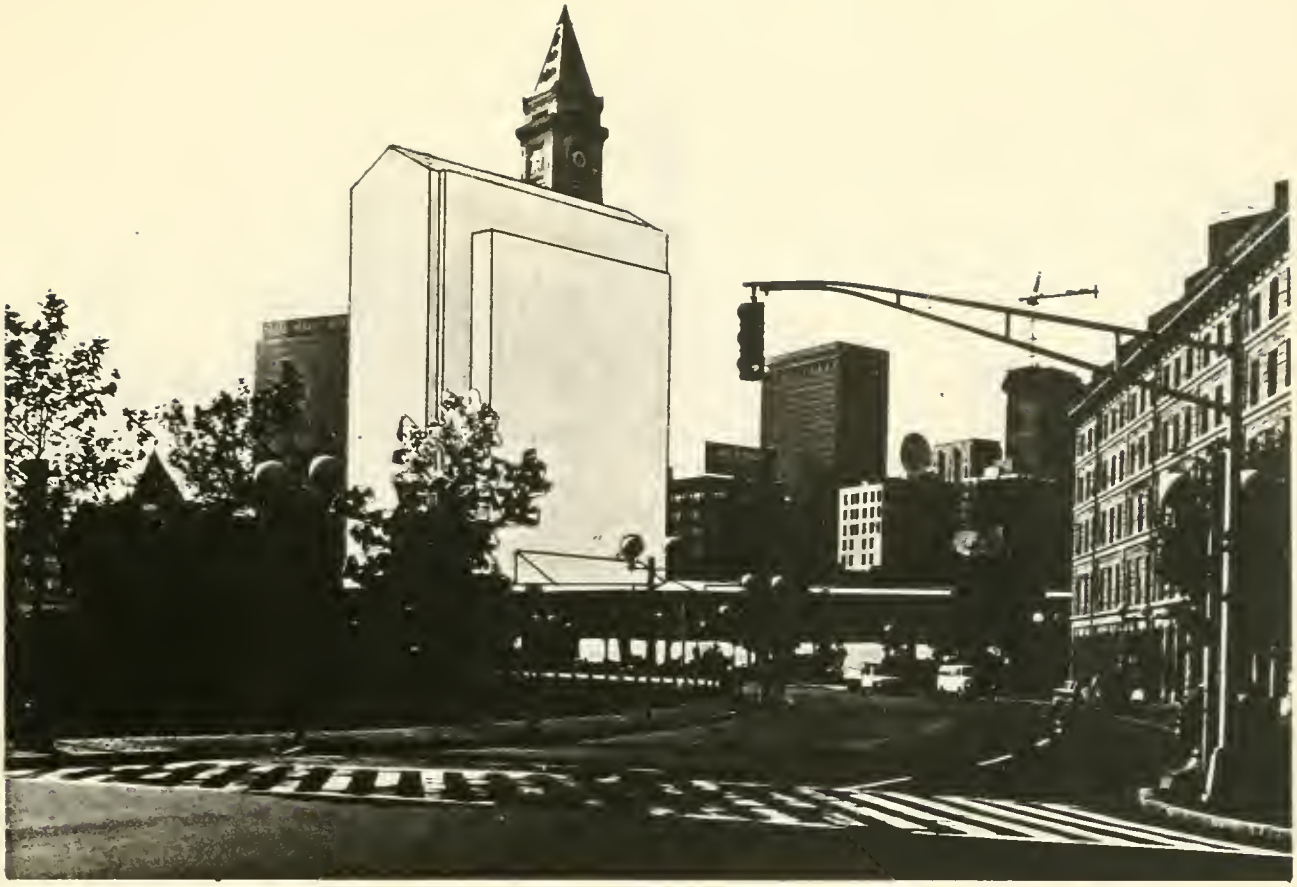
MARKETPLACE CENTER

ABOVE: Existing

Next Page

TOP: 286' high tower

BOTTOM: 220' high tower.



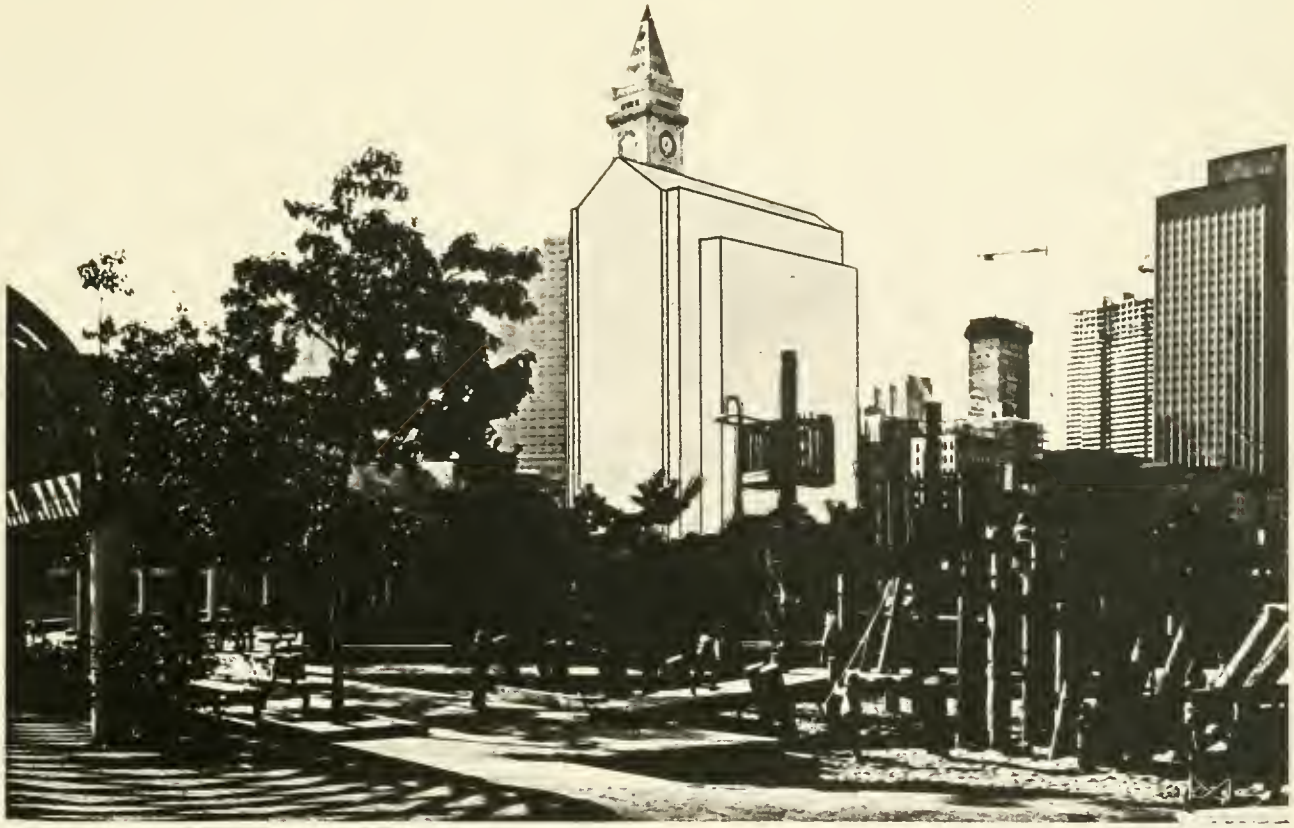
MARKETPLACE CENTER

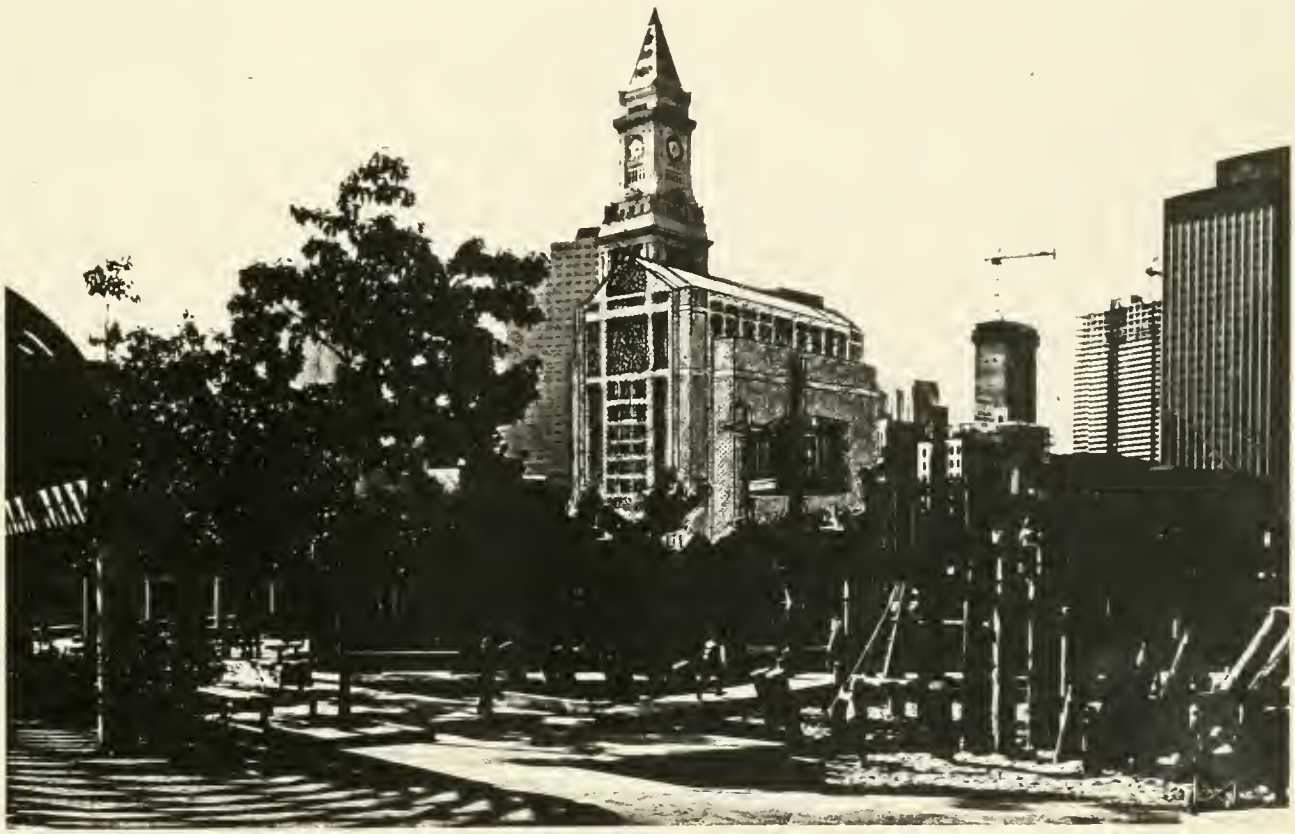
2 ABOVE: Existing

Next Page

TOP: 286' high tower

BOTTOM: 220' high tower.





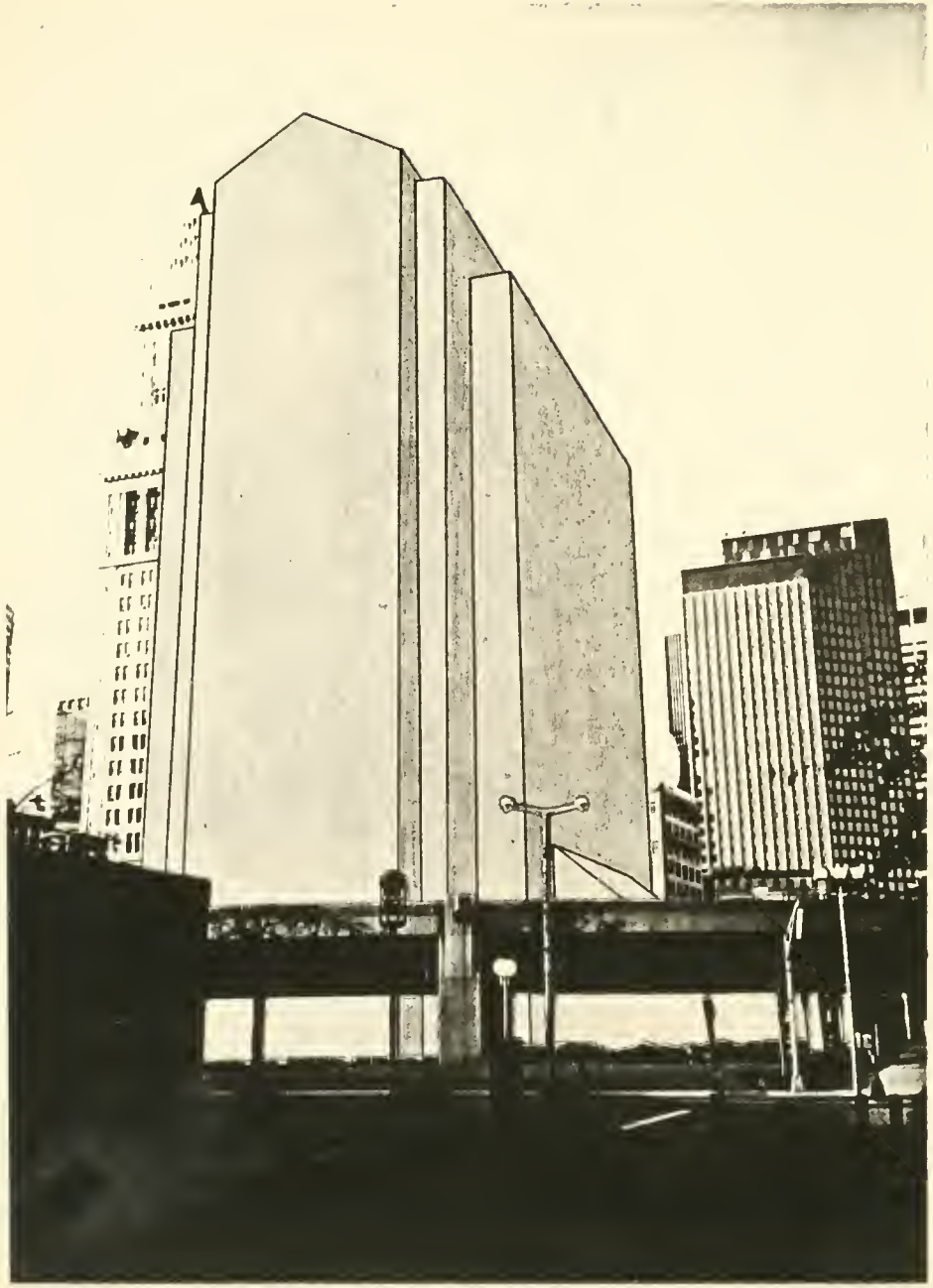
MARKETPLACE CENTER

3 ABOVE: Existing

Next page

LEFT: 286' high tower

RIGHT: 220' high tower



MARKETPLACE CENTER

4 ABOVE: Existing

Next Page

TOP: 286' high tower

BOTTOM: 220' high tower.

Back in style with CB Sports.
The Ski Market

Back in style with CB Sports.
The Ski Market

MARKETPLACE CENTER

5 ABOVE: Existing

Next Page

TOP: 286' high tower

BOTTOM: 220' high tower.

6 Existing

286' high tower

MARKETPLACE CENTER

7 ABOVE: Existing condition

Next Page

TOP: 286' high tower

BOTTOM: 220' high tower.

BOSTON

BOSTON

5. Geologic (construction) Impacts

There will be insignificant effects to geological conditions only during the construction period (1982-1983). There will be some minor de-watering for pile cap excavations with soil subsidence occurring only in the immediate pile cap areas. The driving of piles without pre-augering in the vicinity of the MBTA Blue Line tunnel could affect the structural integrity of the tunnel by producing excessive subsurface vibrations. Therefore, all pile installations will be pre-augered.

6. Impacts to Existing Utility Systems

All measures to mitigate impacts to the existing, on-site utility systems have been developed in consultation with representatives of the utilities involved. This consultation process to date is documented in Appendix IV.

7. Transportation and Traffic Impacts

There will be no major changes to transportation services due to the implementations of the project. Therefore, special provisions to increase service capacity in the immediate vicinity of the project need not be explored. Access of service vehicles to retail/commercial developments will be retained under an arrangement similar to that at Downtown Crossing, whereby Commercial Street from Chatham Street to Clinton Street will be paved in brick, with limited hour servicing.

8. Air Quality

There are no alternative designs which would significantly alter future local air quality conditions. Most of the carbon monoxide concentrations are related to vehicle emissions in the vicinity of the major intersections. Congested traffic conditions at these intersections are the result of capacity exceedances of the major arteries throughout Boston rather than local backups. It should be emphasized that the BRA Developer Solicitation specified garage access was to be from Under Artery.

9. Noise Impacts

9.1 Short-Term Impacts

There are structures in the area which are susceptible to subsurface vibrations such as major utility lines, the MBTA Blue Line tunnel, and Faneuil Hall Marketplace buildings.

Drop hammer, diesel cylinder, and pneumatic or steam pile driving can result in tremendous subsurface shock waves as well as noise peaks of 110 A-weighted decibels or

more. Therefore, all piles will be pre-augered despite the additional expense, to insure that there is no damage to surrounding structures.

Most of the construction noise is derived from stationary, partially mobile, and mobile internal combustion engines. These sources are usually diesel powered with most of the noise emanating from the exhaust outlet and to a lesser extent, inlet and structural sources.[3] The replacement of diesel powered engines with quieter gasoline engines or steam generators can result in some significant noise attenuation. Other noise mitigation devices such as outfitting equipment with proper mufflers and intake silencers aid in the management of construction noise. Placing equipment which is partially mobile (i.e., cranes) and stationery as far away from noise sensitive areas should be part of operational procedures. Another source of noise mitigation for the latter two types of equipment consists of either constructing separate enclosures or erecting portable noise barriers along the perimeter at the site. The use of portable barriers would be the most effective noise mitigation measure if certain principles are addressed during placement of the barriers. These consist of ensuring the wall is free of breaks and that the line of sight from construction to the noise sensitive area interupted. Thus, the plywood barrier to be erected around the perimeter will be at least 8 feet high, and will be 12 feet high, as required by the BRA, immediately adjacent to the Faneuil Hall Markets. This will result in a drop of as much as 5d BA in ground level construction noise. Much of the construction noise which occurs above ground level will not be attenuated. Therefore, the developer will adhere to the following construction practice.

* No construction activity will commence prior to 6:00 A.M. or terminate later than 6:00 P.M., unless extended hours are necessary to maintain the project schedule.

* All equipment will be well maintained and in proper working order.

* Impact tools and other sources of excessive noise will be fitted with state-of-the-art noise suppressors or enclosed in sound absorption chambers to reduce noise levels to applicable federal, state, or local guidelines.

[3] Bolt, Beranek and Newman, 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. U.S.

Environmental Protection Agency.

ENERGY USE

Note:

The MEPA unit has a detailed computer energy analysis which was submitted earlier, and is available for review at that office. The following letter outlines the effects on energy use of a reduction of 100,000 + square feet of office space.

Cosentini Associates

CONSULTING ENGINEERS

Associate Partner
R. P. Leber, P. E.

Chief Engineer
Joseph G. Nahas

Partners
M. A. Mass, P. E.
J. Weisbin, P. E.
D. Michaeli, P. E.
D. Mozur, P. E.
A. Tinfo, P. E.

41 Brattle Street, Cambridge, Mass. 02138

Telephone (617) 876-3830

RECEIVED
APR 08 1982

April 7, 1983

WZMH GROUP INC.
Sears Crescent Building
Boston, MA 02108

ATTENTION: Dave Ordorica

Re: Marketplace Center
Our Project No: 8191

Gentlemen:

Persuant to your and Marketplace Center Associates' requests, we are writing regarding the Building Mechanical System which our office designed for the project.

As stated in our letter of October 18, 1982, the Variable Air Volume Induction Type System with electric in-duct heating coils was selected as the Air Conditioning System for this building. Included in this system is an economizer system consisting of a plate heat exchanger which allows "free cooling" when the outside temperature permits.

The annual energy consumption for the office portion of the project according to the Energy Analysis Program ESP-II is 55,000 BTUH/Sq. Ft./Yr. By deleting five (5) typical floors or approximately 100,000 sq. ft., the consumption remains the same because it is based on a per square foot area.

For a detailed description of design parameters and other schemes considered, please refer to our letter dated October 18, 1982, which replies to the Office of Environmental Affairs' Comments.

We hope that the above information satisfies any questions you may have. If there are any additional questions, please feel free to contact me.

Very truly yours,

James D. Magarian

James D. Magarian

pmb

cc John Dolby (Marketplace Center Assoc.)

Cosentini Associates

Associate Partner
R P Leber P E

Chief Engineer
Joseph G Nana

CONSULTING ENGINEERS

44 Brattle Street, Cambridge, Mass. 02138

Telephone (617) 876-3830

Partners
M A Mass P E
J Weisbin P E
D Machuca P E
D Mozzo P E
A Tinio P E

WZMH GROUP
MARKETPLACE

November 17, 1982

WZMH GROUP INC.
Sears Crescent Building
City Hall Plaza, 4th Flr.
Boston, MA 02108

ATTENTION: David Ordorica

Re: Marketplace Center
Our Job No: 8191

Gentlemen:

We are writing to confirm our telephone conversation with Ms. Sandy Uyterhoeven of the Massachusetts Office of Environmental Affairs on Thursday, November 4, 1982, regarding the above mentioned project.

1. The question was raised why operable windows were not incorporated into the design of the office tower.

   Our response was that by utilizing operable windows, the potential for an extreme amount of energy waste is evident. It would be virtually impossible to monitor if windows would be closed during the air conditioning cycle. Also, humidity levels could not be maintained when the windows are open.

2. The building air conditioning system, utilizing a water to water plate heat exchanger was discussed. This system, as discussed, utilizes free cooling in the winter months via the chilled water circuit rejecting heat gain from the building to the condenser water and then to the cooling tower. The refrigeration machines will only operate in the winter months when the outside temperature is above 45°F.

3. An active solar system for the building domestic hot water was studied in an earlier analysis. It was determined however, that due to the relatively small amount of hot water that an office building uses, the solar system would not be economically feasible and could not be justified.

Cosentini Associates

11 Brattle Street Cambridge Mass 02

Should you have any additional questions relative to the above, please feel free to contact me.

Very truly yours,

James D. Magarian

James D. Magarian

pmb

Cosentini Associates

Associate Partner
R. P. Leber, P. E.

CONSULTING ENGINEERS
44 Brattle Street, Cambridge, Mass. 02138
Telephone (617) 876-3830

WZMH GROUP, INC.
MARKETPLACE
D. Michaels, P. E.
Mozur, P. E.
Imfo, P. E.
RM
MJ
DO
RM
FILE

November 5, 1982

WZMH GROUP INC.
Sears Crescent Building
City Hall Plaza, 4th Flr.
Boston, MA 02108

ATTENTION: Dave Ordorica

Re: Marketplace Center
Our Job No: 8191

Gentlemen:

This is to confirm my telephone conversation with John Dobie regarding the questions raised by the BRA.

1. The annual energy consumption for the office portion of the project is 54,000 BTU's per square foot per year based on a 5½ day/week, 10 hours per day. The annual energy consumption for the retail area of the project is approximately 80,000 BTU's per square foot per year based on a 7-day/week, 14-hour per day operation. The average annual energy consumption for the entire Marketplace Center Project will be 57,500 BTUs per square foot per year.

2. The Marketplace Center Project will require a 36,000 gallon sewage holding tank in order to comply with criteria established by the Boston Water and Sewage Commission (see attached report). The 36,000 gallon sewage holding tank is located under the tower portion of the project near the center of mass for the tower. The hydrostatic uplift on the sewage holding tank will be counteracted by the mass of the tower.

3. The sewage holding tank will be designed to provide thermal storage (chilled water) for the project in the future. Our office, during the initial systems feasibility phase of the project, analyzed thermal storage (chilled water) for this project. At this point in time, economic viability of thermal storage could not be proven. Our analysis of thermal storage (tank capacity in excess of 100,000 gallons) indicated that the capital cost of the tank, if assigned to the mechanical system, could not be justified by the savings in operating costs within a reasonable time frame. In order for the economics of thermal storage to be justified, the capital cost of the thermal storage tank must be assigned to a building system component other than the mechanical. As an example, if the structural foundation design required deep grade-beam type structures which would naturally form a storage holding tank, the cost of the tank is attributable to the structural building component and economic feasibility could be proven..

Sertiri Associates 44 Brattle Street Cambridge, Mass 02138

The structural system proposed for Marketplace Center does not provide a tank like structure and the entire tank cost must be borne by the mechanical building component. Therefore, thermal storage has not been included as part of the original design concept. However, with increasing electric utility company power costs and the fact that the sewage holding tank is not a mechanical penalty, thermal storage utilizing the holding tank will become viable when the tank is abandoned.

If you have any questions regarding the above, please contact me.

Very truly yours,

Richard Leber

Richard Leber

pmb

Appendix I

Transportation and Traffic Report

NOTE:

The information contained herein was prepared on the basis of a building which contained over 100,000 sq. ft. more of office space than the present proposal. Since no adverse effects were identified as a result of the occupancy load of the larger building, it follows that with substantially less office space, occupancy figures and trip generation for office workers will be reduced by approximately 1/3.

Also, the underground garage, which will be only for occupants of the building, will contain 120 cars instead of 155 cars.

TRANSPORTATION AND TRAFFIC REPORT

I. Existing Conditions

Street and Highway Network

A number of the regions' major highways provide access to the immediate vicinity of the Marketplace Center project. Interstate Route 93 passes immediately adjacent to the site via the Boston Central Artery. Access from the north and west via Storrow Drive occurs at North Street, one block from the project. Access to the south and west via the Massachusetts Turnpike occurs several blocks to the south via the Purchase Street and Northern Avenue Ramps. The Sumner/Callahan Tunnels provide direct access to Logan International Airport as well as the northeast suburbs. They are located just north of the project site and are accessible via the Under Artery roadway.

The principal local streets serving the Marketplace Center area are State Street, Commercial Street and the John F. Fitzgerald surface road (Under Artery roadway). State Street is a one-way westbound roadway connecting Atlantic Avenue east of the project site to Congress Street, Washington Street and Cambridge/Tremont Streets via Court Street. The Under Artery is the primary north-south street in the vicinity of the project. It is a six lane divided roadway immediately beneath the Central Artery. South of State Street it is paralleled by Atlantic Avenue, another major six lane street. Access to the Southeast Expressway and Massachusetts Turnpike is primarily via either Atlantic Avenue or the Surface Road. Commercial Street is a one-way northbound street which primarily serves abutting properties. One of its major uses is to provide truck access to the Quincy Market development.

Traffic volumes on major project area streets for the P.M. peak hour and the peak 8 hours are indicated in Figures I-1, I-2.

Levels of service at the major intersections within the project vicinity are indicated in Table 1 and range from A to E for various peak hours.

Public Transportation System

The Marketplace Center project site is within short walking distance of several rapid transit lines, commuter bus lines and commuter ferry terminals.

The MBTA Blue Line stops at Aquarium Station 400' walking distance and State Street Station (1000 foot walking distance). The Orange Line stops at State Street and Haymarket Square (1500 feet), and the Green Line has stops at Haymarket Square and Government Center (1600 feet). Several north shore commuter bus lines stop at Haymarket Square and

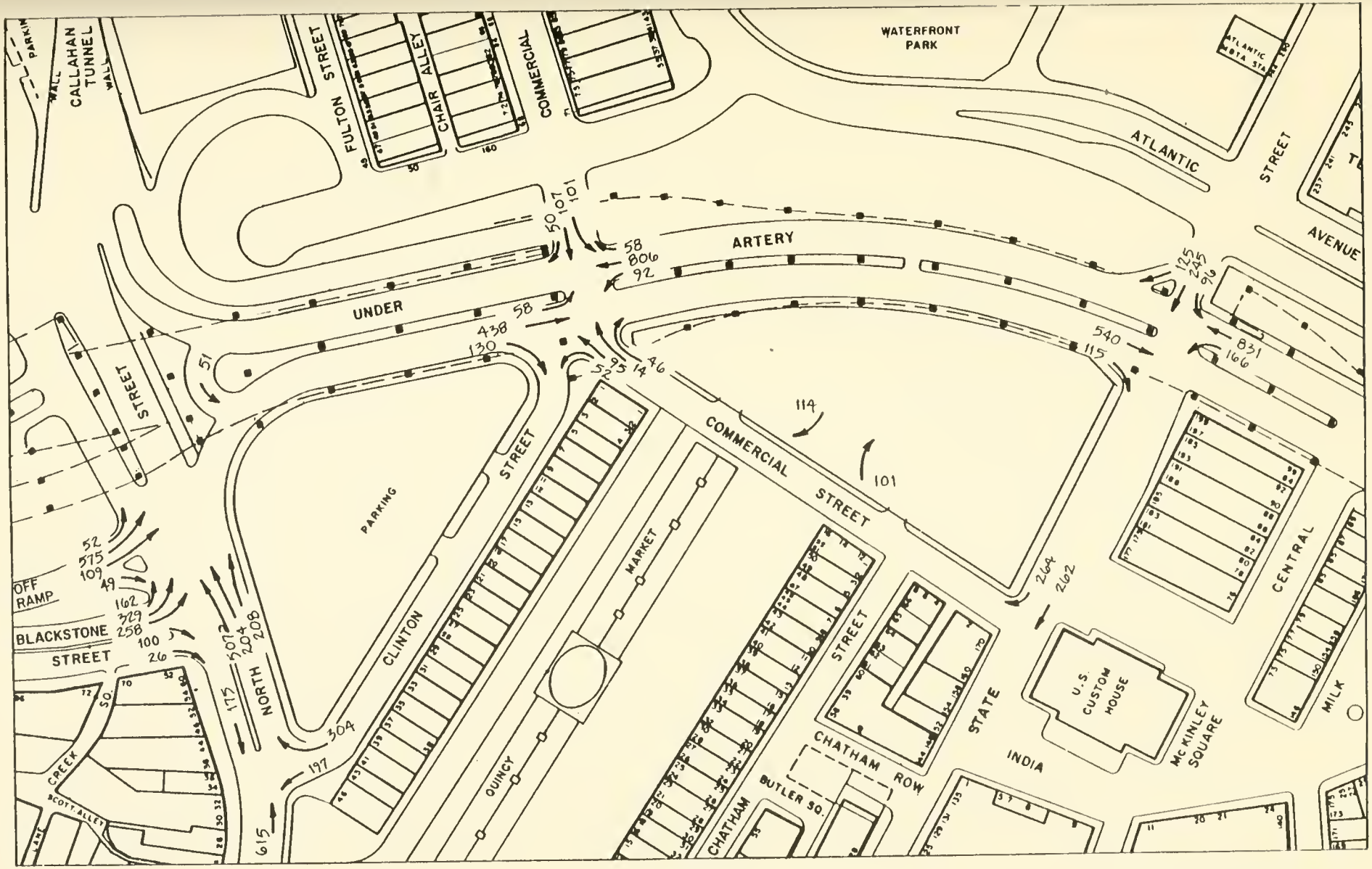


Figure I-1
Traffic Volumes
1982 Existing
PM Peak Hour (4:30-5:30pm)

0 100 200 ft

Sasaki Associates, Inc.

Marketplace Center
Boston, Massachusetts

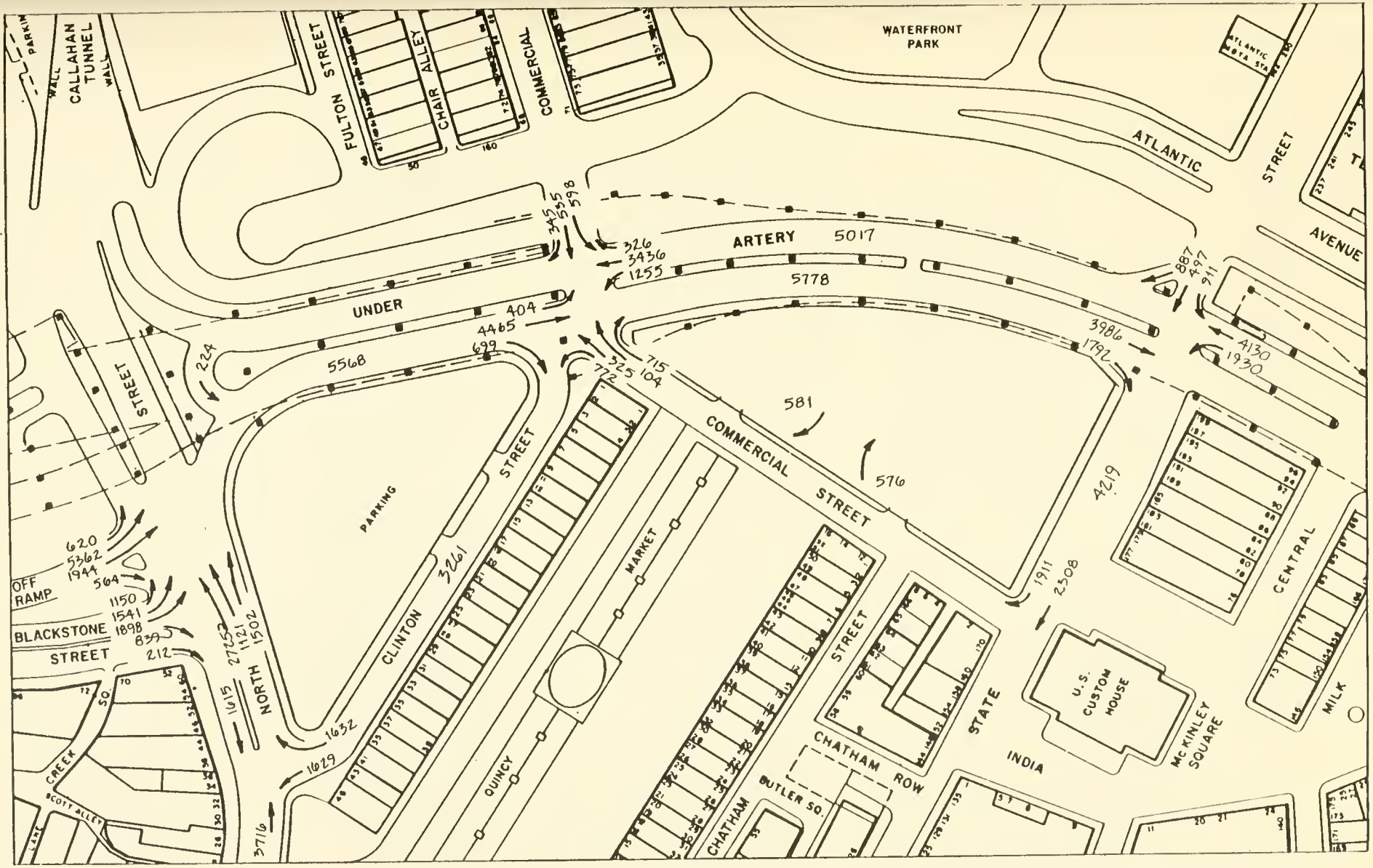


Figure I-2
Traffic Volumes
1982 Existing
Eight Hour

0 100 200 ft

Sasaki Associates, Inc.

Marketplace Center

Boston, Massachusetts

commuter boat service from the South Shore is available at Long and Rowe's Wharfs.

TABLE 1

EXISTING LEVEL OF SERVICE (VOLUME/CAPACITY RATIOS)

	AM Peak Hour 8:00 - 9:00	PM Peak Hour 4:30 - 5:30
State Street/Under Artery	A (.568)	B (.683)
Clinton Street/Commercial Street/Under Artery	A (.604)	D (.811)
Blackstone Street/North Street/Off Ramp	E (.916)	E (.978)

Parking Facilities

Within a five minute walk to the Marketplace Center project area there currently exists a total of 2,801 off-street parking spaces which are open to the public. This is exclusive of the existing 179 spaces on parcel D-10 itself, which are also open to the public for a fee. The largest are the Dock Square garage on Clinton Street (597 spaces), the Waterfront Garage on Milk Street (850 public spaces), and the Kilby Street Garage (700 spaces).

Immediately beyond the five minute circle are an additional 3600-4500 public spaces.

Pedestrian Circulation

The Marketplace Center Development Parcel is bisected by the Walk-to-the-Sea pedestrian way which connects the Government Center/Faneuil Hall/Quincy Market areas to the Waterfront. Large numbers of pedestrians use this walkway primarily during the noon hour, evenings and on weekends. Counts taken during the past several years show that 3,000 to 5,000 pedestrians were using this connection during these peak hours.

II. Traffic Prediction Methodology

Traffic volumes to be generated by the proposed Marketplace Center development have been estimated for the projected completion date of 1987, as well as for the 1987 No Build option, which was used as a base condition (Figures I-3 to I-6).

The estimation process, which has been used in other Environmental Impact Reports for major developments in Boston, contains the following steps:

- Person-Trip Generation
- Employee/Non Employee Trip Distribution
- Peak/Off-Peak Distribution
- Modal Split
- Vehicle Occupancy Rates
- Trip Distribution to Approach Corridors
- Trip Assignment to the Proposed Street System

This process and the result of its application are described in detail in the following pages.

Marketplace Center Development Program

The anticipated development program, summarized for traffic analysis purposes is presented in Table 2.

TABLE 2

MARKETPLACE CENTER DEVELOPMENT PROGRAM

USAGE	AREA IN GROSS SQUARE FEET
Retail	58,700
Office	378,384
Museum	5,000
TOTAL	442,084

Person Trips

The office and retail generation rates were based on findings presented in the report by Wilbur Smith and Associates (1972). The office rate - 7.3 person trips/day/direction - reflects the average of the study's sample of major Back Bay and Downtown office buildings. As a comparison, the Institute of Transportation Engineers (ITE, 1976) has determined that trip generation rates for office buildings range from 2 to 22 trips per 1000 square feet per day with an average of 5.8.

Additionally, trip generation rates for large shopping centers (over 1,000,000 square feet) range from 8 to 28 trips per 1000 square feet per day. Although the retail/commercial element of the Marketplace Center project is considerably less than 1,000,000 square feet, it is felt that the attractiveness of the Faneuil Hall Marketplace area will generate the volume of person trips normally associated with a larger retail entity.

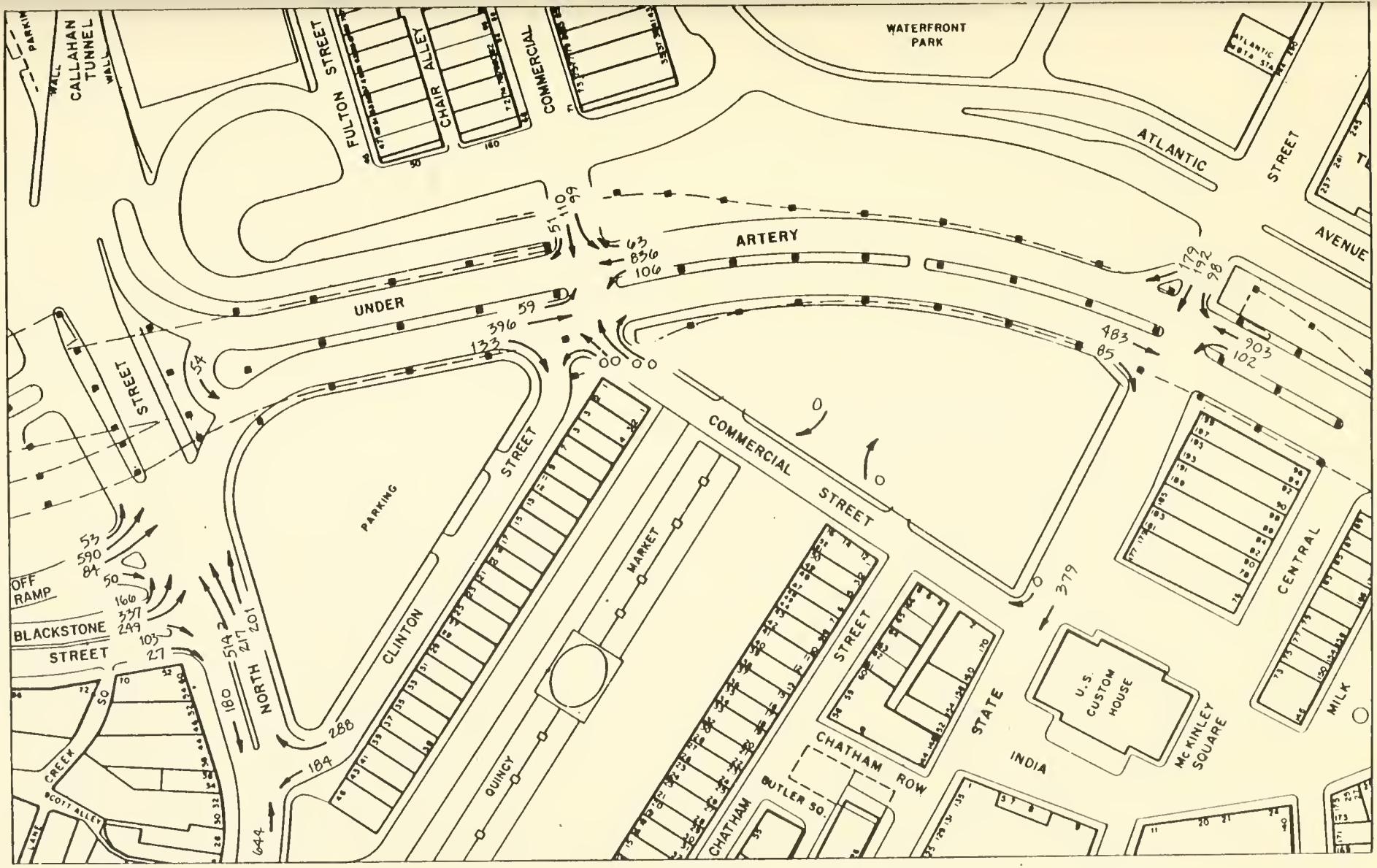


Figure I-3
Traffic Volumes
1987 Build
PM Peak Hour (4:30-5:30pm)

0 100 200 ft

Sasaki Associates, Inc.

Marketplace Center
Boston, Massachusetts

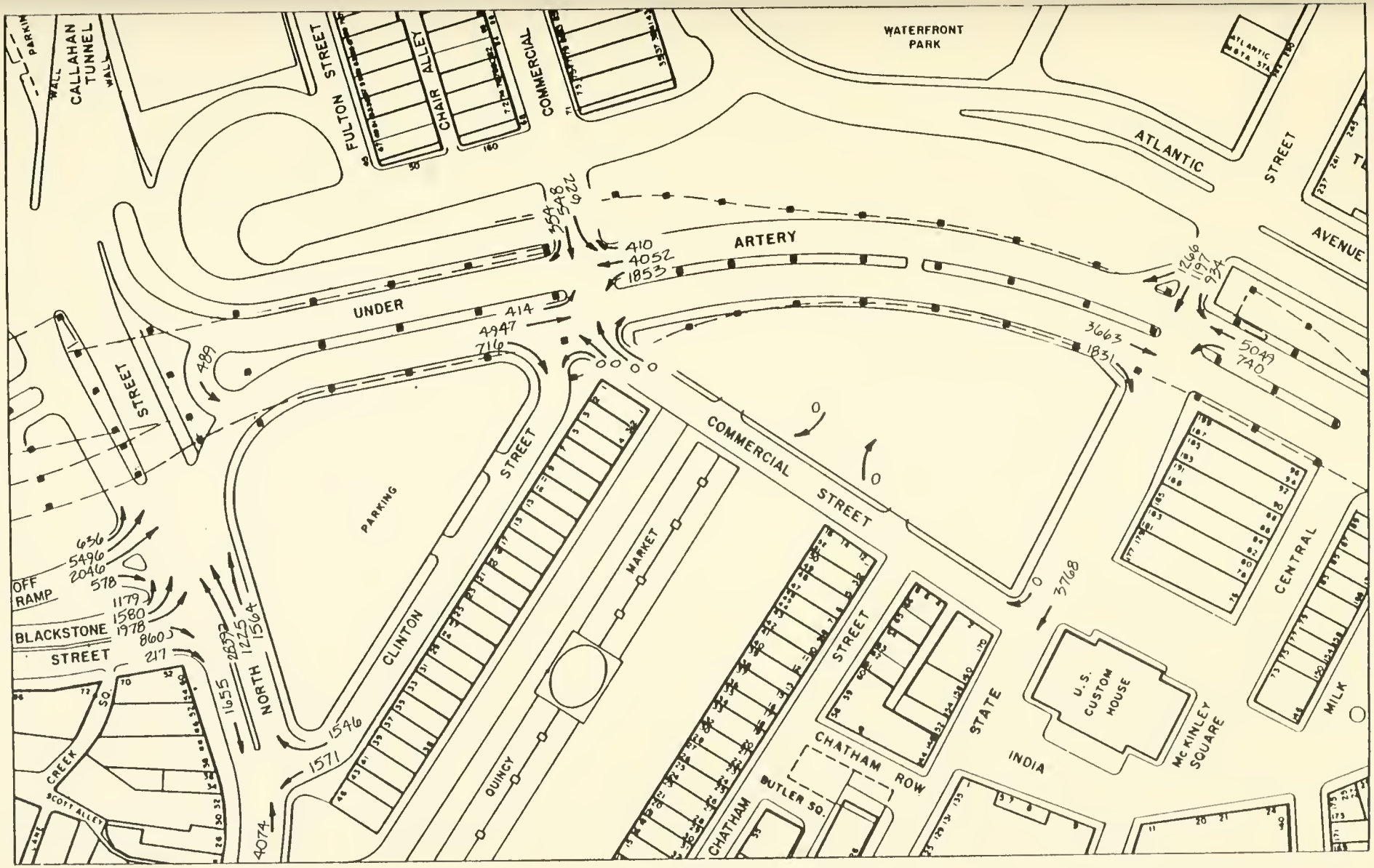


Figure I-4
Traffic Volumes
1987 Build
Eight Hour

0 100 200 ft

Sasaki Associates, Inc.

Marketplace Center

Boston, Massachusetts

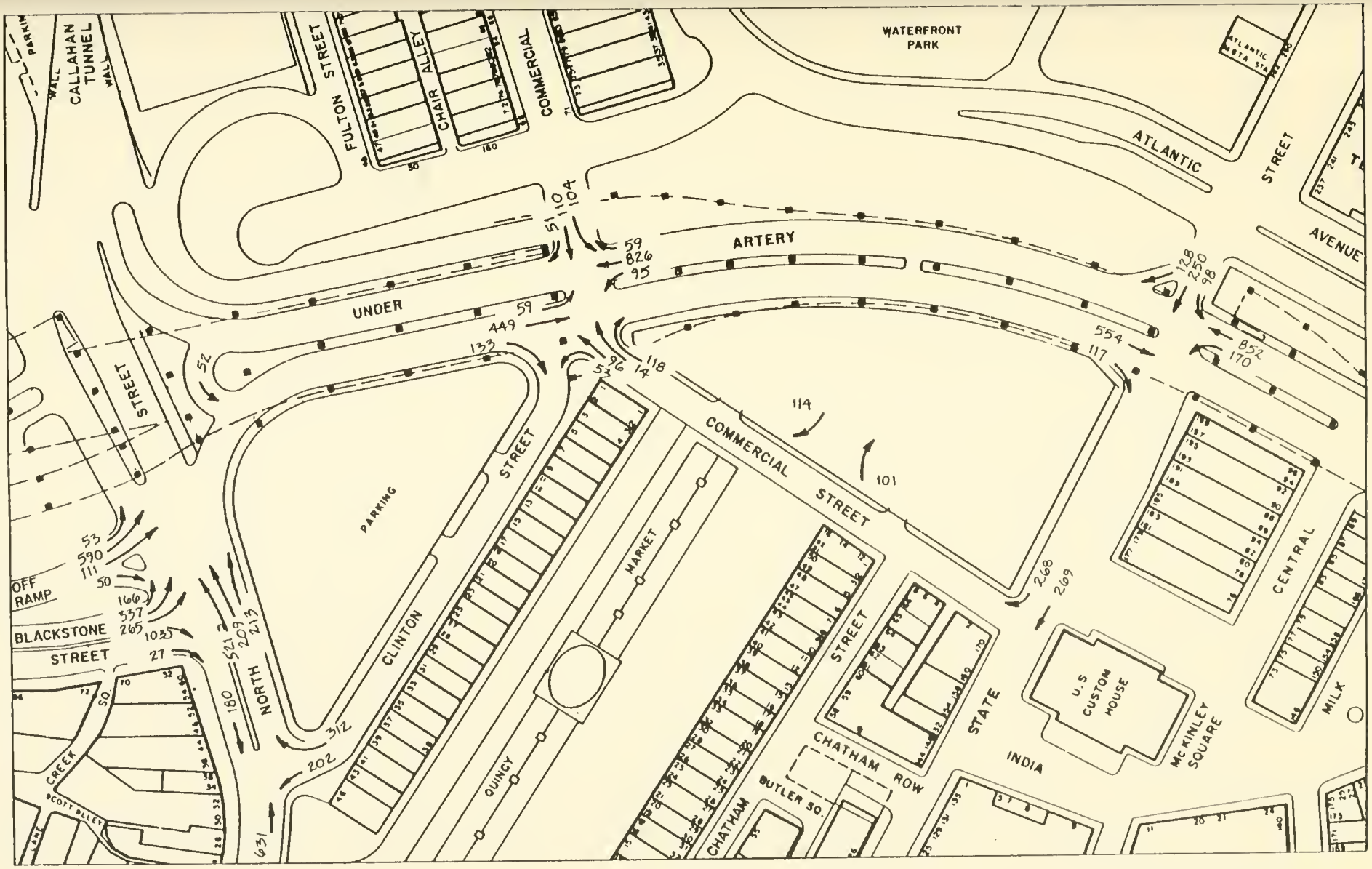


Figure I-5
Traffic Volumes
1987 No Build
PM Peak Hour (4:30-5:30pm)

0 100 200 ft

Sasaki Associates, Inc.

Marketplace Center
Boston, Massachusetts

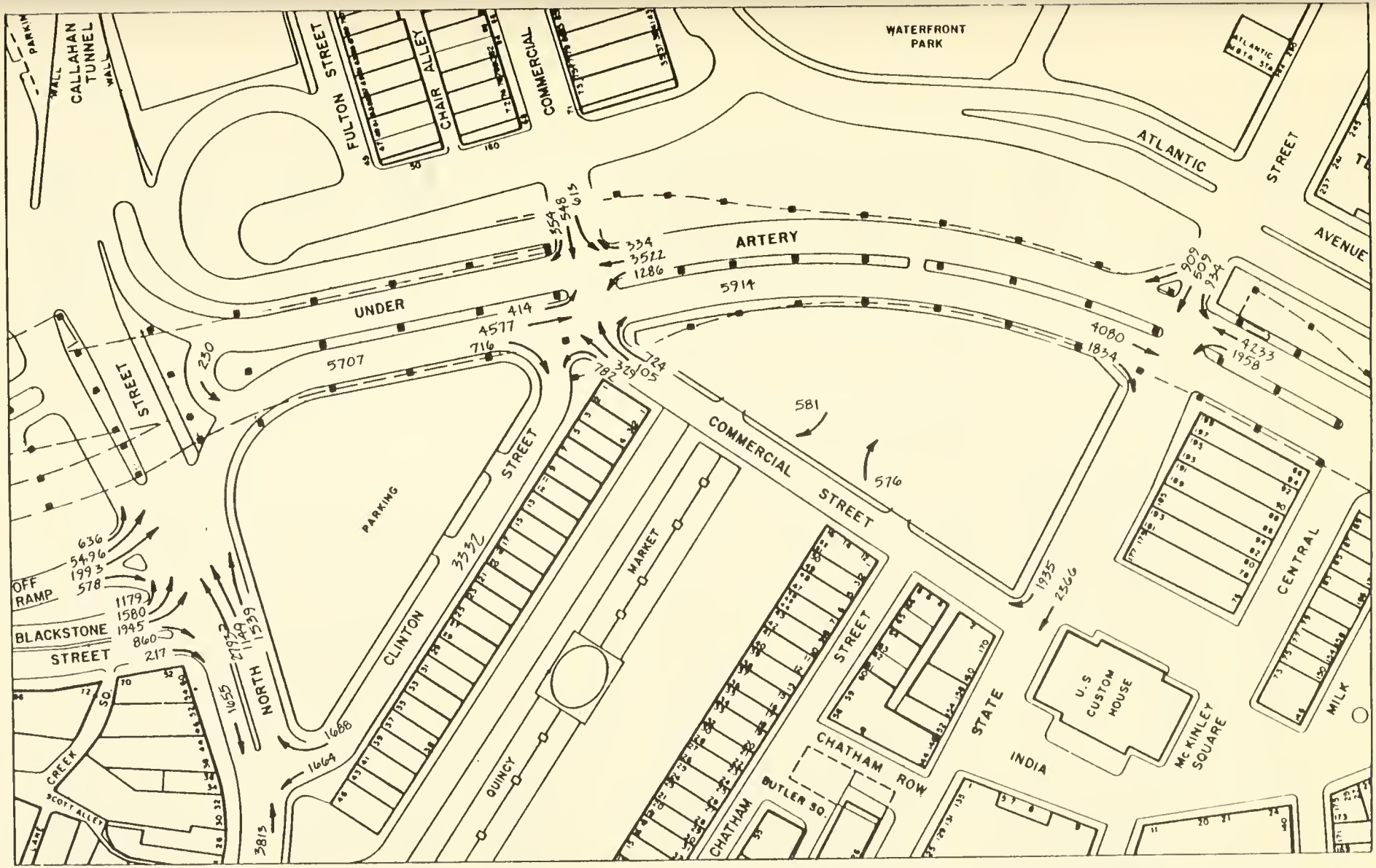


Figure I-6
Traffic Volumes
1987 No Build
Eight Hour

0 100 200 ft

Sasaki Associates, Inc.

Marketplace Center
Boston, Massachusetts

The trip generation rates applied to the proposed Marketplace Center project are presented in Table 3.

TABLE 3

MARKETPLACE CENTER WEEKDAY TRIP GENERATION

	RATE OF ARRIVALS PER DAY	DAILY PERSON ARRIVALS
Retail	18.3/1,000 s.f.	1,075
Office	7.3/1,000 s.f.	2,760
Museum	10/1,000 s.f.	50
		3,885

Directional Flows for Peak and Off-Peak Hours

Person trips by employees and non-employees from surrounding land uses to Marketplace Center (Table 4) were used as a basis for determining the peak hour and off-peak hour assignments of traffic. Table 5 summarizes peak hour and off-peak hour assignments by percentages; Table 6 converts these percentages to actual person trips destined to and from the Marketplace Center project. These findings are based on reports by Cambridge Systematics, Inc. (1975) and the Boston Redevelopment Authority (1980) and were revised for the Marketplace Center Project. Morning and afternoon peak travel periods are each approximately two hours in length and are separated by a seven hour off-peak period.

TABLE 4
EMPLOYEE/NON-EMPLOYEE PERSON TRIPS

	% OF TRIPS	DAILY PERSON ARRIVALS
Retail		
Employee	15	160
Non-Employee	85	915
Office		
Employee	66	1,820
Non-Employee	34	940
Museum		
Employee	10	5
Non-Employee	90	45
Total		
Employee		1,985
Non-Employee		1 900
		3,885

TABLE 5

PERCENTAGE OF DAILY TRIPS DURING PEAK HOURS
AND PRIME OFF PEAK HOURS

	ARRIVALS			DEPARTURES		
	AM Peak Hour	Off Peak	PM Peak Hour	AM Peak Hour	Off Peak	PM Peak Hour
Retail						
Employee	10	12	10	0	12	20
Non/Employee	0	10	5	0	10	10
Office						
Employee	55	2	0	0	2	55
Non/Employee	10	15	0	0	15	10
Museum						
Employee	10	12	10	0	12	20
No/Employee	0	12	10	0	12	20

TABLE 6

PERSON TRIPS

	ARRIVALS			DEPARTURES		
	AM Peak Hour	Off Peak	PM Peak Hour	AM Peak Hour	Off Peak	PM Peak Hour
Retail						
Employee	16	19	16	0	19	32
Non/Employee	0	91	45	0	91	91
Office						
Employee	1000	36	0	0	36	1000
Non/Employee	94	140	0	0	140	94
Museum						
Employee	1	1	1	0	1	2
Non/Employee	1	6	5	0	6	9

Nearly all office employees arrive during the AM peak period and leave during the PM peak period. Table 5 indicates that 55% of these inbound office employees arrive or leave during the peak hours. On the other hand, only 10% of office visitors arrive or leave during the peak hours.

Significant reverse flows are found in some instances where employees and shoppers may arrive in the PM peak hour.

Modal Split

Modal split, i.e., the proportions of all trips made by auto, transit, or walking, is a very significant variable affecting forecasts of auto traffic. Assumptions that high proportions of visitors will use public transportation (although likely and highly encouraged) might understate future traffic volumes and their environmental impacts. The joint effects of the limited number of parking spaces proposed for the project, the proximity of public transportation in relation to the existing Quincy Market area, will create an urban condition which will significantly favor more transit ridership. The proximity of the project to the downtown and Government Center area will produce, from a traffic standpoint, a congested downtown condition. The large daytime population and relatively short walking distance between stores, offices, residences, government buildings, and leisure time facilities, will result in people staying for a longer period of time once they arrive, more walking around, a greater interchange between visitors and businesses, both office and retail, and an overall lower automobile use than currently exists with the present land use.

With office space being the primary land use in the project, the majority of the retail space is expected to be occupied by establishments catering to the daytime population, and to a lesser degree, the automobile users.

The following specific data describing modal splits currently experienced in Downtown Boston was incorporated in the modal split percentages for the Marketplace Center project.

- At Jordan Marsh's downtown store, 12% of the employees walk to work, 71% use transit, and 15% drive.

- The proportions of office workers using transit or commuter rail are as follows:

- First National Bank	73%
- State Street Bank	68%
- Liberty Mutual	41%
- John Hancock	54%
- Prudential	31%
- Hurley Building	50%
- John F. Kennedy Building	57%

Table 7 summarizes the modal split projected for the Marketplace Center Development.

TABLE 7
MODAL SPLIT

	PERCENT			DAILY PERSONS		
	AUTO	TRANSIT	WALK	AUTO	TRANSIT	WALK
Retail						
Employee	30	60	10	48	96	16
Non/Employee	40	20	40	366	183	366
Office						
Employee	36	54	10	655	982	183
Non/Employee	45	40	15	423	376	141
Museum						
Employee	30	60	10	2	3	1
Non/Employee	40	50	10	19	22	4

Vehicle Occupancy

Vehicle occupancy rate (the average number of riders per car), varies by trip purpose. Average auto occupancy rates in downtown Boston are as follows:

Persons/Vehicle

	Employees	Non-Employees
Office	1.23	1.11
Retail	1.00	1.12

Data presented in the report by Wilbur Smith and Associates (1972) indicates that the following occupancy rates are experienced in downtown Boston:

Non-Home Based Trips	1.44 persons/vehicle
Work Trips	1.1 persons/vehicle
Home Based Non-Work Trips	1.75 persons/vehicle

The auto occupancy rates used in the traffic analysis for Marketplace Center are presented in Table 8.

TABLE 8

AUTO OCCUPANCY RATES

	Retail	Office	Museum
Employee	1.4	1.5	1.3
Non/Employee	1.9	1.1	2.3

III. PROBABLE IMPACTS

Street and Highway Network

Under the proposed Marketplace Center project, the only change in the existing circulation system will occur on Commercial Street between Clinton Street and Chatham Street. This section of roadway will be closed to general traffic. Access to existing developments for service purposes will be retained under an arrangement similar to the Downtown Crossing.

Because of the closing of this street to general traffic, the vehicular entrance to the proposed development will be on the Under Artery between State Street and the Walk-to-the-Sea.

Daily Project-Related Vehicular Traffic

Applying the vehicle occupancy rates to daily person trips by auto yields the daily site-generated traffic indicated in Table 9. Peak hour site-generated traffic by direction is presented in Table 10.

TABLE 9

DAILY MARKETPLACE CENTER VEHICULAR TRAFFIC

Retail	
Employee	34
Non/Employee	193
Office	
Employee	437
Non/Employee	385
Museum	
Employee	2
Non/Employee	8
	1059

TABLE 10

MARKETPLACE CENTER PEAK HOUR
VEHICULAR TRAFFIC

	AM		PM	
	Inbound	Outbound	Inbound	Outbound
Retail				
Employee	4	0	4	8
Non/Employee	0	0	10	38
Office				
Employee	240	0	0	240
Non/Employee	38	0	0	38
Museum				
Employee	1	0	1	1
Non/Employee	0	0	1	2
	283	0	16	327

Approach Sectors

Trips to and from Marketplace Center were allocated to approach streets on the basis of data compiled in an origin and destination survey for the Central Artery (Tippetts, et al., 1978) and supplemented by intersection turning movement counts at the four major intersections in the project vicinity. This assignment is indicated in Table 11.

TABLE 11

PERCENT DISTRIBUTION BY CORRIDOR

	APPROACH	DEPARTURE
State Street	11%	11%
Dock Square	14%	16%
Blackstone Street	18%	-
Under Artery South of State	23%	27%
Commercial Street East of Under Artery	5%	5%
Under Artery to Tunnel	-	10%
Central Artery Ramps North	29%	21%

No Build Traffic Volumes 1987

Existing volumes (1982) within the Marketplace Center project area were increased at an average annual rate of 0.5% to develop the anticipated traffic volumes under the No Build condition for the year 1987. Along Commercial Street, however, site destined vehicle trips were not increased above

the existing because the project site land use was assumed to be the same as the existing: a parking lot with 179 spaces, operating at full capacity.

Build Traffic Volumes 1987

The 1987 No Build traffic volumes were used as a base to determine traffic volumes from the proposed development. The first step in the process was to remove the existing site generated trips from the immediate vicinity of the project. It was then necessary to reassign the remaining traffic to the proposed network, i.e, Commercial Street closed to general traffic. Finally, the anticipated project generated traffic was assigned to the network. Specific assumptions made in the assignment process were:

- One half of the afternoon peak hour inbound traffic would use the on-site garage.
- One half of the capacity of the garage, approximately 80 vehicles, would leave in the PM peak hour. The remaining traffic generated by the project in the PM peak hour would use other garages and lots within the vicinity.

Intersection Capacity Analysis

An analysis of major intersections has been prepared to assess the impact of the Marketplace Center project on the surrounding street systems. The nature of the network is such that there will be a rapid dissipation of site generated traffic to the nearby expressway and arterial street system.

All of the Marketplace Center site specific traffic will be concentrated on the southbound segment of the Under Artery between Clinton Street and State Street. This is due to the location of the parking garage entrance and exit on the Under Artery. However, a median break opposite the garage exit on the Under Artery as a means of redistributing traffic is inappropriate due to poor roadway geometry.

Capacity Calculations

Each of the major impacted intersections has been analyzed for the peak hours for the existing, the 1987 No Build and the 1987 Build conditions. The format was adopted from the Highway Capacity Manual (Highway Research Board, 1965) and evaluates a proposed street system which includes the closing of Commercial Street to general traffic from Chatham Street to Clinton Street.

The method used assumes that each intersection would operate at Level of Service C, which is a standard goal for an urban area such as Marketplace Center. A theoretical capacity was determined for each approach to each intersection using a series of factors based upon the number of left and right turns at each intersection, the percentages of trucks and

busses passing through the intersection, the existence of curb parking or no-parking areas, and the width of each approach. This capacity was then compared to the actual demand volume of traffic during the PM Peak Hour to determine a Level of Service of the intersection. It is important to understand that Level of Service (LOS) is a subjective description of traffic flow quality. The definitions of service are as follows:

LEVELS OF SERVICE FOR DOWNTOWN STREETS

Traffic Flow Conditions
(Approximations, Not Rigid Criteria)

Level of Service	Description	Average Overall Speed	Volume/Capacity Ratio
A	Free Flow (relatively: some stops will occur)	$\leq$ 25	$\leq$ .60
B	Stable flow (delays not unreasonable)	$\leq$ 20	$\leq$ .70
C	Stable flow (delays significant but acceptable)	$\leq$ 15	$\leq$ .80
D	Approaching unstable flow (delays tolerable)	$\leq$ 10	$\leq$ .90
E	Unstable flow (congestion not due to back-ups ahead)	Below 10 but moving	$\leq$ 1.0
F	Forced flow (jammed)	Stop & Go	$\geq$ 1.0

Descriptions of each of the intersections follow.

Blackstone Street/North Street/Southbound Off Ramp -

This intersection currently operates on an E Level of Service in both morning and evening peak hours. No significant changes in volume/capacity ratios or Level of Service are anticipated under either the No Build or Build conditions (Table 12).

Clinton Street/Commercial Street/Under Artery -

Level of Service at this intersection is currently A in the morning peak hour and D in the evening peak hour. With the closing of Commerical Steel to general traffic and the shifting travel patterns, anticipated Level of Service will be B in the morning and B in the afternoon (Table 12).

State Street/Under Artery -

Currently at an A and a B Level of Service, respectively, in the morning and evening peak hours, no significant changes are anticipated under the No Build condition in 1987. Upon construction of the Marketplace Center development, it is anticipated that parking will be eliminated from the southbound portion of the Under Artery roadway between the Walk-to-the-Sea crossing and the new garage entrance/exit. The sidewalk in this vicinity will be widened into the existing parking lane to increase site distance at the garage entrance. Even with the reduction of approach width at this location, no significant changes in Level of Service or volume/capacity ratios are anticipated.

TABLE 12

EXISTING AND ANTICIPATED LEVELS OF SERVICE

	AM			PM		
	Existing	No Build	Build	Existing	No Build	Build
State/ Under Artery	A/.568	A/.560	A/.585	B/.683	B/.700	B/.657
Clinton/ Commercial	B/.604	B/.616	B/.627	D/.811	D/.826	B/.678
Blackstone/ North	E/.916	E/.936	E/.986	E/.978	E/1.0	E/.981

Truck and Taxi Traffic

Surveys have found that 3% of office non-employee arrivals by auto were taxi passengers or were dropped off by drivers who proceeded elsewhere. In the Marketplace Center Development this translates to approximately 12-15 taxi arrivals per day.

Daily truck generation rates anticipated for this development are 0.21/1,000 gsf of office space and 0.24/1,000 gsf of retail space, resulting in approximately 93 truck arrivals per day. Of these, approximately 12-13 will occur in the peak truck hour.

Parking

Off-Street

The existing 179 public off-street spaces are to be replaced with 155 new spaces, all of which will be reserved for the exclusive use of the building tenants and, therefore, not

conflict with the requirements of the downtown Boston parking freeze. The demand for parking spaces anticipated by the development will result in a shortage of 200-400 spaces over the course of the day. When added to the existing 179 spaces to be eliminated, the project will result in the demand for 380 to 580 off-site parking spaces. As stated previously, there are approximately 7,300 public spaces existing within a 5-8 minute walk of the project. The overflow from Marketplace Center will result in a 5% to 8% increase in the utilization of these spaces.

On-Street

Currently, the City of Boston policy generally prohibits on-street parking downtown before 9:30 AM. Because of this restriction, as well as the stepped up parking enforcement program, it must be assumed that morning peak hour demands which cannot be accommodated on-site will necessarily find off-site spaces in the immediate vicinity of the project. Off peak demands may find on-street spaces on a first come, first serve basis and will obviously create an increased demand for the already limited numbers of on street spaces.

LITERATURE CITED

Boston Redevelopment Authority. 1980. North Station urban renewal project interim environmental impact report. Boston Redevelopment Authority.

Cambridge Systematics, Inc. 1975. Transportation impacts of the Park Plaza urban renewal project. Boston Redevelopment Authority.

Institute of Traffic Engineers. 1976. Trip generation. Institute of Traffic Engineers.

Tippetts-Abbett-McCarthy-Stratton. 1978. Boston central artery 1977 origin-destination study. Massachusetts Executive Office of Transportation and Construction and Massachusetts Department of Public Works.

Wilbur Smith and Associates. 1972. An access oriented parking strategy for the Boston metropolitan area. Massachusetts Department of Public Works.

Appendix II

Air Quality Report

I. Purpose and Objectives

The intent of the air analyses is to ensure the project does not result in air quality degradation with respect to the health and welfare of the surrounding community. As outlined in the scope issued on 13 May 1982 by the Executive Office of Environmental Affairs, potential air quality degradation is likely to occur from local traffic emissions. Therefore, a microscale analysis of carbon monoxide was conducted using traffic parameters for 1982 Existing, 1987 No Build and 1987 Build conditions in order to identify potential adverse effects on Faneuil Hall Marketplace and Waterfront Park. The air analysis will enable planners to suggest methods to minimize harm should air quality deterioration occur as a result of the project.

II. Methods and Materials

In an attempt to curtail further nationwide deterioration of air quality, the Environmental Protection Agency established the National Ambient Air Quality Standards (see Appendix A). Those states which are in violation of these standards (NAAQS) are required to attain compliance by a certain date. Massachusetts is in violation of the carbon monoxide and ozone standards and is sanctioned for compliance by 1987. The state agency responsible for enforcement (Massachusetts Department of Environmental Quality Engineering) requires stationary and mobile sources to demonstrate no further air quality deterioration. Therefore, the air analysis must demonstrate either no further air quality degradation over existing conditions or compliance with NAAQS by 1987.

The National Ambient Air Quality Standards are designed to protect human health and welfare by setting time and concentration limits on all the prime air pollutants. Carbon monoxide (CO) from automotive emissions and suspended particulates from both automotive emissions and construction activities are likely to be the most concentrated pollutants found within the project area. Other pollutants of less magnitude will include ozone, oxides of nitrogen, hydrocarbons, and oxides of sulfur. An identification of sources and description of physiology and welfare effects is presented in Appendix B.

Existing Conditions

The Massachusetts Department of Environmental Quality Engineering (DEQE) maintains a network of air monitors throughout the state to aid in determining regulatory actions for the attainment of the NAAQS. DEQE maintains one CO monitor in the Boston CBD at Kenmore Square. The monitor recorded no exceedances of the one-hour NAAQS and 13 exceedances of the eight-hour standard in 1978.

CO "hotspot" monitoring was conducted for the Dock Square Parking Garage Environmental Impact Report in 1978. (Sasaki Associates, Inc., 1978). There were recorded violations of the eight-hour standard of 9 parts per million (ppm). These violations were probably due to conjested intersections coupled with the Central Artery deck acting as a trap to the pollutants. As the proposed project is located within one block from the Dock Square Garage, similar air quality conditions may prevail.

The ambient CO concentration derived from all sources (urban and extraurban) is referred to as the background concentration and is added to the results of a microscale analysis. The background concentrations for this study were derived from the guidelines published by the DEQE (1982) and are presented in the following:

Carbon Monoxide Background Concentrations in ppm

	1 Hour	8 Hour
1982	4.4	1.3
1987	1.0	1.0

Study Area

The air analysis for the project will concentrate on the localized effects of carbon monoxide in areas such as Faneuil Hall Marketplace and Waterfront Park. Individuals are likely to spend prolonged periods of time at these two sites, thus being subject to unhealthy air quality should ambient CO concentrations exceed the NAAQS. By definition, the two sites are air quality sensitive receptors (see Figure II -1).

Traffic on roadways and parking lots in the vicinity of the two sensitive receptors will have the most influence on localized CO concentrations. The proposed development is planned on the parking lot at Parcel D-10, which is bordered by Commercial Street to the west and north, the Under Artery to the east and north, and State Street to the south. Therefore, traffic on these roadways as well as at the intersection of Commercial Street, Clinton Street and the Under Artery at the intersection of the Under Artery and State Street, and at the parking facilities on the site were used for the prediction of CO concentrations. These concentrations were predicted for existing conditions (1982) and the year of NAAQS attainment (1987) with and without the project.

Microscale Analysis

In order to compare the project to the NAAQS, the results must reflect the same time intervals used to establish the standards. The CO standard is based on a one and eight-hour exposure interval. Therefore, the CO concentrations are

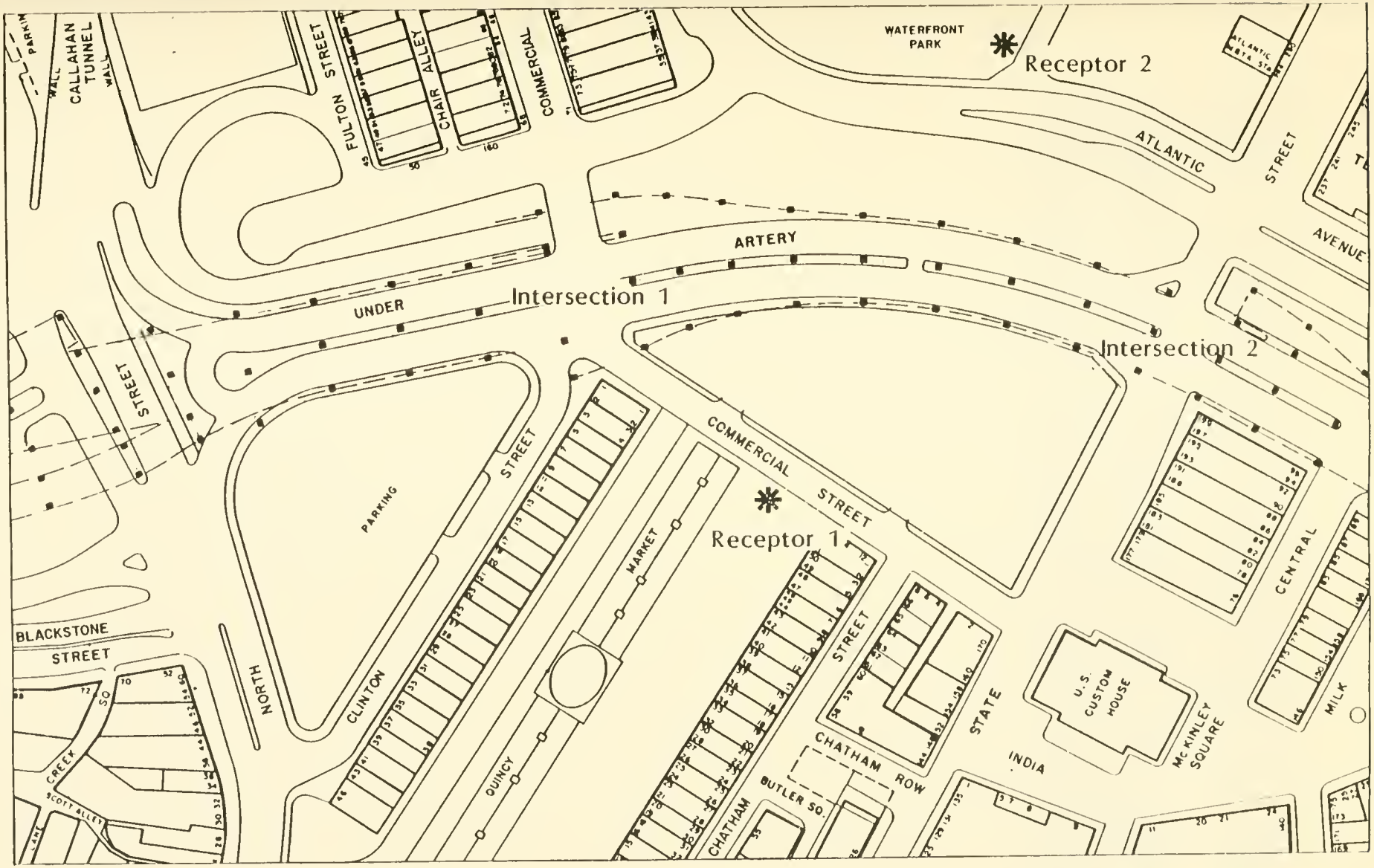


Figure II-1
Location of Sensitive Receptors

LEGEND

✱ Air Quality Sensitive Receptors

0 100 200 ft

Sasaki Associates, Inc.

Marketplace Center
Boston, Massachusetts

expressed as one and eight-hour results based on peak hour traffic (the highest hour of traffic in an average day) and eight-hour traffic (using the one-hour average of the highest volumes occurring over eight continuous hours).

Vehicle speeds for each roadway segment were based on an intersection capacity analysis as outlined in the CO "hotspot" methodology published by DEQE (1982). In order to verify these speeds, a field inspection was conducted by SA personnel on 28 May 1982 at off-peak hours (10:00 to 11:00am). The level of service was compared to the following table prepared by the Highway Research Board (1965) and speeds were chosen accordingly.

TABLE 1

LEVELS OF SERVICE FOR DOWNTOWN STREETS

Traffic Flow Conditions

(Approximations, Not Rigid Criteria)

Level of Service	Description	Average Overall Speed (mph)
A	Freeflow (relatively; some stops will occur)	$\geq$ 25
B	Stable flow (delays not unreasonable)	$\geq$ 20
C	Stable flow (delays significant but acceptable	$\geq$ 15
D	Approaching unstable flow (delays tolerable)	$\geq$ 10
E	Unstable flow (congestion not due to back-ups ahead)	Below 10 but moving
F	Forced flow (jammed)	Stop & Go

Source: Highway Research Board (1965).

Emissions Modeling

Emission rates were derived using the methodology described in MOBILE 2 published by EPA (1981). These rates are dependant on a number of variables presented in Appendix C. Some of the variables included are Massachusetts specific age distribution for light duty vehicles, Massachusetts specific vehicle mix, 20 degrees Farenheit operating temperature, 50 percent cold and 10 percent hot start operating mode for one-hour conditions, and 20 percent cold and 27 percent hot start operating mode for eight hour conditions. Emission rates for freeflow traffic and parking lot idling emissions are presented in Table 2.

TABLE 2

Carbon Monoxide Emission Rates

for the Free-Flow Traffic

Vehicle Speed	% Hot Start	% Cold Start	Emission Rate (gm/mile) 1982	1987
10	10	50	192.4	123.5
15	10	50	144.5	92.8
20	10	50	116.4	76.9
25	10	50	94.5	62.7
10	27.3	20.6	125.8	84.6
15	27.3	20.6	94.5	63.6
20	27.3	20.6	75.6	52.3
25	27.3	20.6	60.5	42.6
*IDLE	-	-	10.7	6.9

*gm/minute

Dispersion Modeling

The emissions model yeilds the amount of CO emitted at the tailpipe of one representative vehicle. The next step entails estimating cumulative emissions and predicting CO dispersion behavior downwind from the immediate source. Local and areawide meteorological forces such as wind speed, wind direction, and vertical and horizontal atmospheric turbulences are the determinants of CO dispersion behavior.

Dispersion prediction was based on the methodology described in Guidelines for air quality maintenance planning and analysis: Volume 9 published by EPA (1978). "Worst case" variables (those which result in the most adverse air quality) were used as input to the methodology to ensure a conservative approach to air quality maintenance. DEQE and MEPA concurred on the selection of input variables such as one meter per second wind speed for one-hour conditions, 3 meters per second wind speed for eight-hour conditions, Pasquill-Gifford daily stability of D, and an initial vertical dispersion of 5.0 meters. "Worst case" wind direction conditions for each intersection, freeflow traffic (on the Under Artery, Commercial Street, and State Street), and the area sources (parking lot and parking garage) were determined by applying wind angles at fifteen degree increments to the 1982 one-hour Existing and 1987 one-hour Build conditions. In addition, CO emissions from more than one source, aligned under "worst case" wind direction conditions and added to appropriate background concentrations to estimate adverse conditions at the two sensitive receptors.

Intersection Disperson

The analysis included other variables not previously mentioned. At the intersection of Clinton Street, Commercial Street, and the Under Artery (Intersection 1, see Figure II-1) there are four phases to the signal cycle. The third phase is an 18 second pedestrian actuated light. In order to account for this in the dispersion analysis, it was assumed that the pedestrian phase was in use every other cycle.

For intersection 1 and intersection 2, (the Under Artery and State Street) the off-peak signal cycle operates from 8:30 am to 2:30 pm and the pm peak signal cycle operates from 2:30 to 6:00 pm. The change of signal cycle was averaged for the eight-hour analysis (10:00 am to 6:00 pm).

Under the Build condition, an automobile restriction will be placed on Commercial Street from Chatham Street to Clinton Street. Therefore, Commercial Street (northbound) was eliminated from the Intersection 1 analysis for the 1987 Build one and eight-hour analysis. The calculation sheets for Intersections 1 and 2 (one and eight-hour conditions) are presented in Appendix D.

Street canyon effects are created in areas where buildings surrounding a street are taller than the wind penetration depth. This situation creates a vortex motion when wind flows over the tops of the building altering the regular dispersion behavior of air pollutants at ground level. For Existing and No Build conditions, there are no buildings on parcel D-10 which would interfere with prevailing winds and subsequent dispersion of CO. However, the Marketplace Center building will be constructed to an elevation at least equal to the height of the Central Artery viaduct. This could create a significant alteration to prevailing wind currents. Therefore, the street canyon model described in Volume 9 (EPA 1978) was applied to Intersections 1 and 2 and Under Artery freeflow. This analysis is presented in Appendix E.

Free-flow Analysis

It was assumed that some of the freeflow traffic in the vicinity of the project could elevate CO levels in the vicinity of the sensitive receptors. Freeflow traffic on Commercial Street from State Street to Clinton Street, State Street from the Under Artery to Commercial Street, and the southbound and northbound lanes of the Under Artery from Commercial Street to State Street were used for this analysis. Not all the freeflow traffic will effect the receptors at different wind angles. For instance, State Street freeflow traffic will influence CO levels at Receptor 1 (Faneuil Hall Marketplace) with east to southeast winds (90^{o} to 165^{o}) and Receptor 2 (Waterfront Park) with from southeast to southwest winds 165^{o} to 240^{o} (see Figure II-1). Additionally, distance (152 meters) in conjunction with relatively low traffic volumes on Commercial Street would result in negligible CO concentrations within the vicinity of Receptor 2. Therefore, Commercial Street freeflow was not analyzed for Receptor 2. The calculation sheets for the freeflow traffic emissions are presented in Appendix F.

Area Sources

Under Existing and future No Build conditions, the site is occupied by a parking lot with space for 179 vehicles. In order to estimate the effects of vehicles travelling in this area, the parking lot was analyzed as an area source following the methodology described in Volume 9 (EPA 1978). There is an estimated turnover of vehicles every four hours during working hours. This rate is reflected in the Existing and future No Build traffic projections.

The proposed Marketplace Center building will provide parking for 120 vehicles in an enclosed garage at ground level. The access and egress for the garage will be located along the southbound lane of the Under Artery approximately 30 meters north of Intersection 2. The vehicle emissions originating in the garage will be expelled through two ventilation ducts at a rate of 300,000 cfm each. The openings (2.6 meters in diamater)

of the ducts are located on the east facade at the building at a height of 6.7 meters above the ground.

The emission rate for the garage was calculated by the following equation:

Q=FTV/3600 (g/s)
Where: F=the idling emission rate (gs)
T=the average running time in the garage for a vehcicle to enter and park or unpark and exit (in seconds). It was assumed that the majority of vehicles would be exiting at pm peak and time (T) would be no more than 50 seconds. For the eight-hour is also assumed to be no more than 50 seconds.
V=the total number of cars entering and exiting during the hour (vehicles/hour).

Estimation of CO dispersion from the ventilation system was accomplished by using a Gaussian virtual point source equation (Briggs, 1971, 1972, 1975). Briggs' equation for momentum plume rise was applied to the ventilation duct emissions. Plume rise was approximately 26 meters above the exhaust duct which indicates that dispersion of CO occurs above the top of the Central Artery. Therefore, winds originating in the east will align the emissions with Receptor 1 and winds from the west will align the emissions with Receptor 2.

All equations and calculations for dispersion of CO emissions from area sources are presented in Appendix G.

III. Results and Discussion

The modeling results presented in Tables 3 through 5 indicate existing traffic conditions have the potential to cause unhealthy air conditions at the eastern end of the Faneuil Hall Marketplace and the southwestern edge of Waterfront Park. Each source of emissions (Intersection 1, Intersection 2, freeflow traffic, and area source) alone under "worst case" wind direction and meteorological conditions does not result in CO concentrations above the NAAQS. However, in cases where "worst case" wind directions align more than one source and the background concentration is also added, exceedances of the one and eight-hour concentrations exist. This is prevalent under wind directions from the north (0^{o}) where traffic conjestion at Intersection 1 and freeflow traffic on the Under Artery and Commercial Street result in one and eight-hour CO concentrations of 36.0 and 8.9 ppm for 1982. Additionally, winds from the northwest (270^{o}) align emissions from Intersection 1 and freeflow traffic on the Under Artery with Receptor 2 resulting in 11.1 ppm under eight-hour 1982 conditions.

TABLE 3

Carbon Monoxide Concentrations at Receptor 1

(expressed in parts per million)

	1982 Existing		1987 No Build		1987 Build	
	1-Hour	8-Hour	1-Hour	8-Hour	1-Hour	8-Hour
Intersection 1	25.4	6.7	20.3	5.2	6.4	3.8
Intersection 2	10.6	3.2	8.4	2.3	<.02	<.02
Freeflow Traffic	6.2	1.2	3.8	1.3	NA	NA
Area Source	1.1	0.2	0.7	0.3	<.02	.36

TABLE 4

Carbon Monoxide Concentrations at Receptor 2

(expressed in parts per million)

	1982 Existing		1987 No Build		1987 Build	
	1-Hour	8-Hour	1-Hour	8-Hour	1-Hour	8-Hour
Intersection 1	18.4	8.6	19.9	7.3	16.4	7.0
Intersection 2	15.3	3.0	11.3	2.3	11.0	2.2
Freeflow Traffic	6.6	1.3	4.3	0.7	5.9	0.9
Area Source	0.5	0.1	0.3	0.1	<.02	.36

TABLE 5
Worst Case Carbon Monoxide Derived from all Sources
and Background Concentration (expressed in parts per million)

	1982 Existing		1987 No Build		1987 Build	
	1-Hour	8-Hour	1-Hour	8-Hour	1-Hour	8-Hour
Receptor 1						
. Intersection 1 . Freeflow Traffic . For o degree wind direction	36.0	8.9	24.9	7.5	7.4	4.8
. Intersection 2 . Freeflow Traffic . For 35 degree wind direction	18.5	5.1	11.5	3.5	1.0	1.0
Receptor 2						
. Intersection 1 . Freeflow Traffic. . For 270 degree wind direction	29.9	11.1	23.3	8.7	20.7	8.5
. Intersection 2 . Freeflow Traffic. . For 180 degree wind direction	24.3	5.4	15.4	3.6	16.4	3.4

Note: Area sources had negligible effect on local CO concentrations.

There were no exceedances of the NAAQS in 1987 under No Build conditions even though traffic volumes increased. Thus was due to the Federal Motor Vehicle Control Program which is aimed at reducing future emissions by requiring emission control devices installed in new model vehicles.

The results of the 1987 Build conditions were below the 1987 No Build CO concentrations and the NAAQS. The Build condition results in a local reduction in traffic volume due to the automobile restriction placed on Commercial Street thus eliminating that vehicle queue from Intersection 1. The multi-story building also acts as a natural wind barrier to ground-level emissions. For instance, winds from the east, south, and southeast will have no effect on Receptor 1 and winds from the north will align traffic emissions only from the southbound lane (intersection analysis) at the Under Artery with Receptor 1 yielding a one-hour concentration of 7.4 ppm. A wind from the northwest (270°) will align Intersection 1 and freeflow traffic on the Under Artery with Receptor 2 to result in one and eight-hour CO concentrations of 20.7 and 8.5 ppm. A "worst case" wind direction from the southwest (180°) will align Intersection 2 and freeflow traffic on the Under Artery and State Street with Receptor 2 to yield one and eight-hour CO concentrations of 16.4 and 7.0 ppm. A street canyon effect was applied to 1987 one hour Build conditions and found not applicable therefore omitted from further analysis. It should also be mentioned that "worst case" wind angles from intersection and freeflow sources did not align with wind angles affecting area sources. Additionally, both the parking lot and garage resulted in emission effects below background CO concentrations and therefore did not have a significant effect on local air quality.

Literature Cited

Briggs G.A. 1971. Some recent analyses of plume rise observations. Proceedings of the Second International Clean Air Congress.

Briggs G.A. 1972. Chimney plumes in neutral and stable surrounding. Atm. Env. 6(7): 307-510.

Briggs G.A. 1975. Plume rise predictions. Lectures on Air Pollution and Environmental Impact Analysis. American Meteorological Society, Boston, MA.

Highway Research Board. 1965. Highway capacity manual. National Academy of Sciences, National Research Council. Publication 1328.

Massachusetts Department of Environmental Quality Engineering. 1979. Massachusetts air quality data summaries for 1979.

Massachusetts Department of Environmental Quality. 1982. Draft technical memorandum #3: Background values.

Massachusetts Department of Environmental Quality. 1982. Draft Massachusetts state implementation plan for ozone and carbon monoxide.

Sasaki Associates, Inc. 1978. Dock Square parking garage parcel E-8, draft environmental impact report. Dock Square Parking Associates.

Turner, D.B. 1970. Workbook of atmospheric dispersion. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 1978. Guidelines for air quality maintenance planning and analysis volume 9 (Revised): evaluating indirect sources.

U.S. Environmental Protection Agency. 1981. Guide to Mobile 2 (Mobile source emissions model) user's manual.

APPENDIX A

NATIONAL AND MASSACHUSETTS AMBIENT AIR QUALITY STANDARDS

National and Massachusetts Ambient Air Quality Standards

Contaminant	Type of Average & Averaging Time	Primary Standard	Secondary Standard
Hydrocarbons	3-hr. (6 to 9 A.M.)	160 ug m3 (0.24 ppm)	**Same
Sulfur	Annual Arithmetic Mean	80 ug/m3 (0.03 ppm)	Same
	*Maximum 24 Hour Average	365 ug/m3 (0.14 ppm)	Same
	*Maximum 3 Hour Average	None	1300 ug/m3 (0.5 ppm)
Total Suspended Particulates(TSP)	Annual Geometric Mean	75 ug/m3	**60 ug/m3
	*Maximum 24 Hour	260 ug/m3	150 ug/m3
Carbon Monoxide (CO)	*Maximum 8 Hour Average	10 ug/m3 (9 ppm)	Same
	*Maximum 1 Hour Average	40 ug/m3 (35 ppm)	Same
Ozone	*Maximum 1 Hour Average	240 ug/m3 (0.12 ppm)	Same
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	100 ug/m3 (0.05 ppm)	Same
Lead (Pb)	*Three Month Average	1.5 ug/m3	Same

* Not to be exceeded more than once per year.
** This is a guide to be used in assessing implementation plans.

Source: Massachusetts Department of Environmental Quality Engineering, Massachusetts State Implementation Plan for Ozone and Carbon Monoxide, May, 1979.

APPENDIX B

DESCRIPTION, SOURCES, AND EFFECTS OF MAJOR TRANSPORTATION-RELATED POLLUTANTS

Description, Sources, and Effects of Major Transportation-Related Pollutants

Carbon Monoxide(CO)

CO is a colorless and odorless gas which is generated by the incomplete combustion of fossil fuels. CO is an inert gas and remains fairly concentrated in the immediate vicinity of its source. This phenomena allows for accurate prediction of disperion behavior and is the pollutant used to indicate air quality deterioration from traffic emissions within a local area (microscale analysis). Toxicity in humans is a result of the pollutants high affinity to hemoglobin, subsequently reducing the oxygen carrying capacity of the blood. Physiological responses include delayed reaction times and reduced visual sensitivity under low concentrations (10-13 ppm), and headaches, nausea, dizziness, and eventually death under high concentrations (200-2,000 ppm). CO concentrations normally encountered under ambient conditins have relatively no effect on plants and materials.

Total Suspended Particulates (TSP)

TSP are defined as any material existing in the solid or liquid phase which exists in the atmosphere under normal conditions. This primary air pollutant is derived from industrial processes, fuel combustion, agricultural activities, wind erosion, and construction activities. The latter source, construction activities, will result in the highest concentrations of TSP within the vicinity of Marketplace Center. The amount of TSP released to the atmosphere is determined by the areal extent of the project and by wind conditions and may be easily controlled by standard construction practices. Physiological symptoms include irritation to lung tissue in individuals suffering from respiratory illnesses. Human welfare effects include plant damage as a result of surface cover, reduced visibility, and erosion of materials from wind blown dust.

Hydrocarbons (HC)

HC is made up of a number of different compounds and is derived from the incomplete combustion of fuels. In the unreactive state, these pollutants are not particularly detrimental to human health or welfare. However, photochemical reactions under certain atmospheric conditions cause smog which can reduce visibility, cause eye irritation and worsen respiratory problems.

Oxides of Nitrogen (NOx)

Oxides of nitrogen occur as nitric oxide and nitrogen dioxide in the atmosphere. These are emitted during combustion of fuels under high temperature conditions. Nitrogen dioxide induces nose and eye irritation; under high concentrations, there is a correlation with bronchitis and pneumonitis. Combination of nitrogen dioxide and water forms nitric oxide which can induce metal corrosion, lowered buffering capacity in lacustrine systems, and plant damage. Nitrogen oxides react with hydrocarbons in the presence of sunlight to form photochemical smog.

Oxides of Sulfur (SOx)

Sulfur dioxide is the most prevalent form of oxides of sulfur and is emitted during the combustion of sulfur bearing fuels such as bituminous coal and residual fuel oil. In combination with total suspended particulates, sulfur dioxide has a strong correlation with bronchitis and emphysema.

Human welfare effects include corrosion of Portland cements, various stones, metals, paper, leather, and textiles.

Photochemical Oxidents

Photochemical oxidents (ozone) are formed by the reaction of hydrocarbons and oxides of nitrogen in the presence of sunlight. Physiological effects include damage to the respiratory tract, aggravation at asthma attacks, and eye irritation. Secondary effects (welfare) include damage to leaves and premature cracking of rubber products.

APPENDIX C

EMISSION FACTORS

* Derivation of Average Emission Factors

Vehicle Classification

77.0%	Light duty gas vehicles (LDGV)
8.6%	Light duty gas trucks Class I gross vehicle weight less than 6,001 pounds (LDGT-I)
4.6%	Light duty gas trucks Class II gross vehicle weight between 6,001 and 8,500 pounds (LDGT-II)
4.2%	Heavy duty gas vehicle (HDGV)
1.2%	Light duty diesel vehicle (LDDV)
.2%	Light duty diesel truck (LDDT)
3.3%	Heavy duty diesel vehicle (HDDV)
.9%	Motorcycles (MC)

* Environmental Protection Agency (1981). User's guide to MOBILE 2 (mobile-source emissions model).

SASAKI ASSOCIATES, INC.
64 PLEASANT STREET
WATERTOWN, MA 02172

PROJECT NO _____ SHEET NO. ____ OF ____
TITLE _____ DATE 4/3/82
BY _____ CK'D _____

1982

Speed mph	I/I gm/mi	Cold start	LDGV	LDGT$_1$	LDGT$_2$	HDGV	LDDV	LDDT	HDDV	MC	TOTAL gm/mi
10	10.0	50.0	192.12	187.16	155.22	464.58	2.75	4.04	23.17	97.28	192.35
15	10.0	50.0	144.45	140.72	116.74	349.31	2.07	3.04	17.42	73.14	144.54
20	10.0	50.0	117.33	116.21	93.83	258.36	1.55	2.24	13.14	55.36	116.45
25	10.0	50.0	95.42	94.87	76.10	204.23	1.24	1.82	10.43	44.51	94.46
10	27.3	20.6	118.24	112.37	93.02	464.58	2.57	3.78	23.17	62.74	125.84
15	27.3	20.6	88.90	84.49	69.94	349.31	1.93	2.84	17.42	47.17	94.53
20	27.3	20.6	72.07	69.66	56.04	258.36	1.45	2.14	13.14	35.75	75.76
25	27.3	20.6	57.66	55.73	44.83	206.69	1.16	1.71	10.51	28.60	60.55
* IDLE	—	—	12.01	8.36	5.50	9.19	.18	.35	.89	3.00	10.46

* gm/min.

PLANNING/ARCHITECTURE/LANDSCAPE ARCHITECTURE/CIVIL ENGINEERING/ENVIRONMENTAL SERVICES

SASAKI ASSOCIATES, INC.
64 PLEASANT STREET
WATERTOWN, MA 02172

SHEET NO ____ OF ____
DATE 6/3/92
BY RA CK'D ____
PROJECT NO 2321.01
TITLE Mashpee Commons

1987 without I/M

Speed mph	Hot Start	Cold Start	LDGV	$LDGT_1$	$LDGT_2$	HDGV	LDDV	LDDT	HDDV	MC	TOTAL gm/mi
10	10.0	50.0	133.94	116.99	74.39	273.29	2.75	4.30	23.17	90.88	123.54
15	10.0	50.0	100.71	87.96	55.93	205.48	2.07	3.23	17.42	68.33	92.85
20	10.0	50.0	84.46	73.50	46.00	151.98	1.56	2.44	13.14	51.42	76.86
25	10.0	50.0	69.09	60.08	37.46	120.13	1.24	1.94	10.42	41.09	62.67
10	27.3	20.6	87.62	71.90	46.04	273.29	2.57	4.02	23.17	57.83	84.59
15	27.3	20.6	65.88	54.06	34.62	205.48	1.93	3.02	17.42	43.52	63.55
20	27.3	20.6	55.25	45.14	28.42	151.98	1.46	2.27	13.14	32.16	52.32
25	27.3	20.6	45.12	36.89	23.16	120.13	1.15	1.80	10.43	26.18	42.57
*IDLE	—	—	8.58	3.72	2.22	5.47	.19	.35	.89	2.52	6.94

* gm/min

PLANNING/ARCHITECTURE/LANDSCAPE ARCHITECTURE/CIVIL ENGINEERING/ENVIRONMENTAL SERVICES

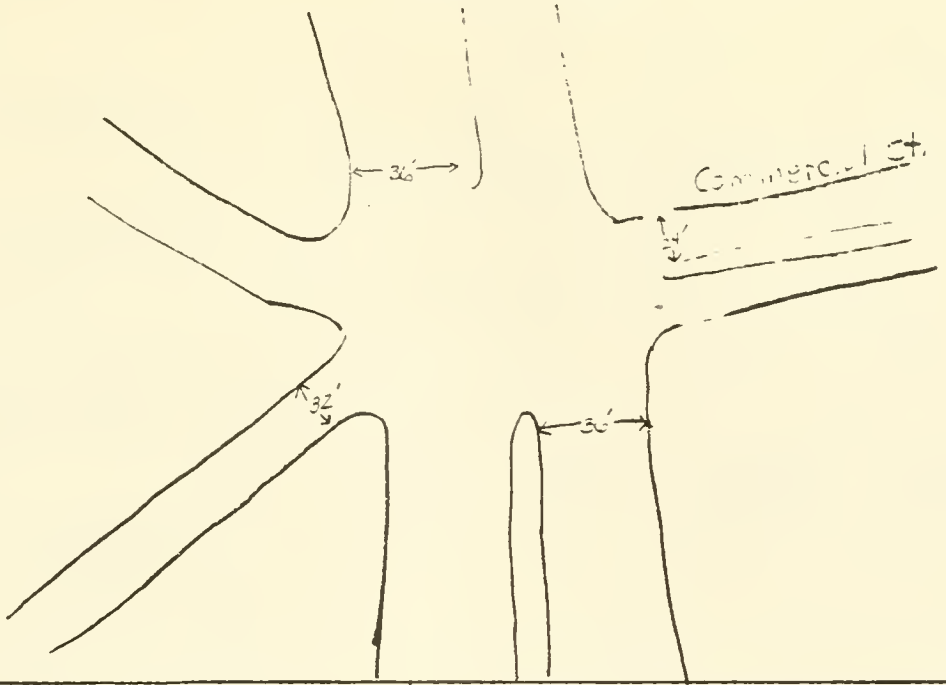
APPENDIX D

INTERSECTION ANALYSIS

INDICATE

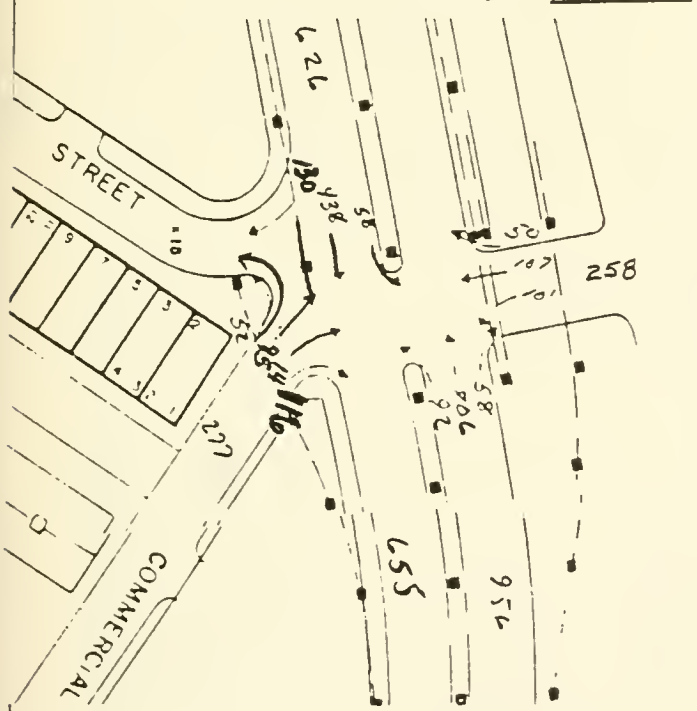
- Right of way
- Pavement widths
- Sidewalks
- Channelization
- Signal
- Medians
- Left storage lane
- Parking restrictions

EXISTING/PROPOSED



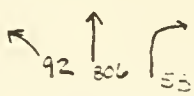
TRAFFIC VOLUMES

Date _____

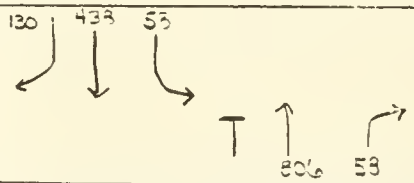


SIGNAL PHASING DIAGRAM

Φ_1

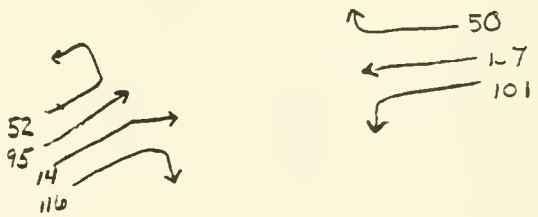


Φ_2



Φ_3 18 second Pedestrian (not used)

Φ_4



Project Title

GEOMETRIC SKETCH PLAN

Drawing Title

INTERSECTION 1 1982 1-HOUR NO BUILD

Project Number

Drawing Number

Drawn By

Scale

Date

Sasaki Associates, Inc.

64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS
WORK SHEET 1982 - NO BUILD

INTERSECTION 1

AM/(PM) (EXIST)/ PROP

FILE NO
DATE
COMP BY
CHECKED BY

GENERAL DESCRIPTION

STREET NAME & DIRECTION	Comm NB	UA SB	UA NB	Comm W	
MOVEMENTS	L-S-R	L-S-R	L S R	L-S-R	
PHASE	4	2	1 & 2	4	

PHYSICAL CONDITIONS

PARKING WITHIN 250'	NO · 1 · (2)	NO · (1) · 2	NO · (1) 2	(NO) 1 · 2	NO · 1 ·
ONE WAY or TWO WAY	1	1	1	1	
APPROACH or LANE WIDTH	32'	36'	36'	24'	

STANDARD APPROACHES

LOCATION: (CBD) F-OBD-R		6.7		6.6		6.6		6.5		
AREA FACTOR	fa		1.00		1.00		1.00		1.00	
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07	.85	1.07	

SPECIAL APPROACHES

L or R TURN LANE (NO. SEP o)	I7						
L or R LOW TYP. (SEP o)	I8-A						
L or R HIGH TYP (SEP o)	I8-B						
DBL. L or R H.T. (SEP o)	I8-D						
"T" or "Y" (INCL. CASE TYPE)	F-13						
SPECIAL "T" (OPTION LANE)	F-12	V'=	V'=	V'=	V'=	V'=	
LEFT TURN ADVANCE GREEN	F-10						
OTHER (SPECIFY)							
FOR I8-D & F-13 ONLY: TURNING ANGEL	f_Δ						
FOR I8-D & F-13 ONLY: ENT. WIDTH	fwe						

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	0.95	10	0.95	10	0.95	10	0.95	
% LEFT TURNS	fl	42	1.00	21	0.98	6	1.01	19	0.93	
% RIGHT TURNS	fr	52	1.00	9	1.00	10	1.00	39	0.90	
NO. BUSSES / HOUR	fb	-	-	-	-	-	-	-	-	
INTERMEDIATE FACTOR Fi = fa · fpphf · f_Δ · fwe · ft · fl · fr · fb		1.02		1.00		1.03		0.95		

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4			4			
CYCLE LENGTH (SEC.)		C	100			100			100			100			
DESIGN	RATIO	Y/C	.04			.04			.04			.04			
DESIGN	INT SV., DESIGN (SV · Fi)	ISV	1450	1479		2160	2160		2160	2224		1950	1658		
DESIGN	DESIGN HOUR VOLUME	DHV	277			626			956			258			
DESIGN	DESIGN G/C = DHV / ISV	DG/C	.187			.290			.430			.16			

LEVEL OF SERVICE DETERMINATION Σ Y/C + Σ DG/C = LOS =

ANALYSIS OF SERVICE LEVELS			A	B	(C)	(A)	B	C	(A)	B	C	(A)	B	C		
ANALYSIS	GREEN INTERVAL (SEC)	G	20			53			59			20				
ANALYSIS	RATIO	G/C	.2			.53			.59			.2				
ANALYSIS	COMPOSITE FACTOR fi · G/C	fc	.2			.53			.61			.17				
ANALYSIS	CHART SERVICE VOLUME	CSV	1290	1350	1530	1920	2010	2160	1920	2010	2160	1850	1890	1950		
ANALYSIS	ACTUAL SERVICE VOLUME	ASV	258	276	306	1018	1065	1145	1166	1221	1314	314				
ANALYSIS	PEAK HOUR VOLUME	PHV	277	277	277	626			956			200				

COMMENTS

rgm 7-80

Intersection 1 — 1992 1-Hour No Build

WORKSHEET 8--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 2026.01 Analyst: R. Longley

Site: Marketplace Center Date: 6/7/92 CKD R. 6/23/92

Step	Symbol	Input/Units	Traffic Stream			
			NB	SB	NB	W
1	i	Road segment (or approach identification)	Comm	U.A.	U.A.	Comm
2	V_i	Demand volume (vph)	277	626	956	258
3	C_i	Free-flow capacity (vph)	—	—	—	—
4	S_i	Cruise speed (mph)	15	25	25	25
5	Ef_i	Free-flow emissions (n/veh-m)	.089	.059	.059	.059
6.1	H_i	Number of lanes in approach i	3	3	3	2
6.2	j	Signalized intersections phase identification	4	2	1&2	4
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1530	1920	1920	1950
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	277	626	956	258
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	20	53	59	20
6.7	C_i	Capacity of approach i (vph)	362	1252	1556	377
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.98	0.70	0.92	.93
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	8	12	22	7
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	3.2	0.9	1.6	2.2
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	30	34	63	37
9	Rq_i	Average excess running time on approach (s/veh)	71	19	21	58
10	Ea_i	Excess emissions from acceleration (g/veh-m)	0.17	0.11	0.11	0.11
11	Ed_i	Excess emissions from deceleration (g/veh-m)	0.06	0.04	0.04	0.04
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	0.018	0.018	0.033	.010
13	Lad_i	Length of acceleration and deceleration (m)	20	56	56	56
14	Le_i	Length over which excess emissions apply (m)	40	40	63	40
15	Fs_i	Average idling emission rate (n/s)	0.93	0.43	0.76	0.68
16	Qe	Average excess emission rate (g/m-s)	0.032	0.036	0.041	0.031
17	Qe'_i	Adjusted excess emission rate (n/s-m)	.025	.029	.028	.027
18	Qfc_i	Free-flow emission rate (g/s-m)	.007	.01	.016	.004

17a 49 .032 .036 .041 .031

17b .007 .007 0.013 .004

Intersection 1 Receptor 1

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

1932 1-Hour
No Build

PROJECT NO. 2026.01 ANALYST. R. Langley
SITE Marketplace Center DATE 6/9/82
Receptor 1

LINE NO	SYMBOL	INPUT/UNITS	TRAFFIC STREAM: CommN	UA3B	UANB	CommW
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	1
3	θ	WIND ROAD ANGLE (deg)	50°	45°	49°	40°
4	x	LATERAL DISTANCE (m)	9	62	76	41
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	82	106	52	141
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	50	73	0	101
7	σ_{z_o}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.025	.029	.028	.027
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.007	.01	.016	.004
9a		STREET CANYON? YES OR NO	no	no	no	no
		DISPERSION ANALYSIS				
10	χ/Q^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	810	140	120	160
	Qf	ENTER LINE 9	x .007	x .01	x .016	x .004
11	χ	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	5.7	1.4	1.9	0.6
	U	ENTER LINE 2	1	1	1	1
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	5.7	1.4	1.9	0.6
13	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	175	100	—	175
	Qe	ENTER LINE 8	.025	.029	.028	.027
14	χ	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	4.4	2.9	—	4.7
	U	ENTER LINE 2	1	1	1	1
15	χ	CO CONCENTRATION - "MAXIMUM QUEUE"	4.4	2.9	—	4.7
16	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	50	62	—	175
	Qe	ENTER LINE 8	x .025	x .029	x .28	x .027
17	χ	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	1.2	1.8	—	4.7
	U	ENTER LINE 2	1	1	1	1
18	χ	CO CONCENTRATION - "IMAGINARY QUEUE"	1.2	1.8	—	4.7
19	χ	CO ($mg\ m^{-3}$) TOTAL	11.3	6.1	1.9	10.0
20	χ	CO CONCENTRATION (ppm) - TOTAL	9.8	5.3	1.6	8.7
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22	— —	z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

25.4

270°

Intersection 1 Receptor 2

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS (see instructions following) 1982 1-Hour No Bkgd

PROJECT NO. 2026.01 ANALYST R. Longley

SITE Marketplace Center Receptor 2 DATE 6/13/82

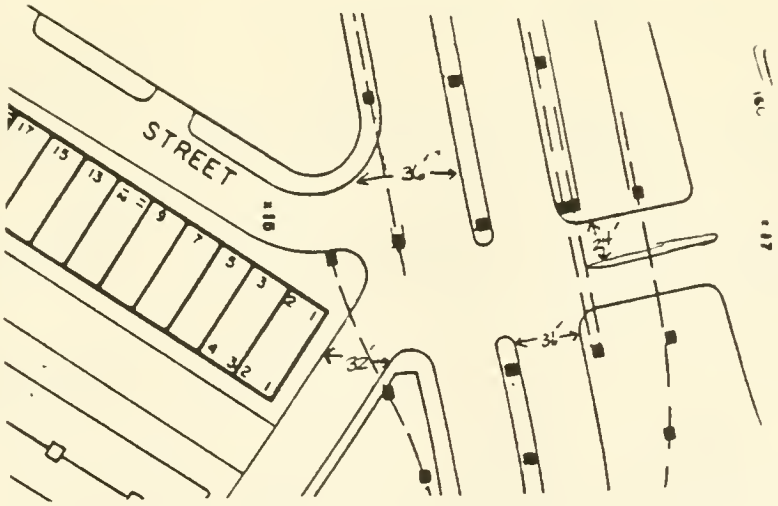
LINE NO	SYMBOL	INPUT UNITS	TRAFFIC STREAM CommN	UA SE	UA NB	CommW
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	1
3	θ	WIND ROAD ANGLE (deg)	87	40	41	52
4	x	LATERAL DISTANCE (m)	149	9	43	146
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	72	201	152	55
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	41	171	87	0
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.025	.029	.028	.027
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.007	.01	.016	.004
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	$\sigma_U U$	NORMALIZED CONCENTRATION ($10^3\ m^{-1}$) FREE FLOW	70	150	160	70
	Qf	ENTER LINE 9	x .007	x .01	x .016	x .004
11	σ_U	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.5	1.5	2.6	0.3
	U	ENTER LINE 2	1	1	1	1
12	σ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.5	1.5	2.6	0.3
13	$\sigma_U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	75	130	175	—
	Qe	ENTER LINE 8	.025	.029	.028	.027
14	σ_U	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.9	3.8	4.9	—
	U	ENTER LINE 2	1	1	1	1
15	σ	CO CONCENTRATION "MAXIMUM QUEUE"	1.9	3.8	4.9	—
16	$\sigma_U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	75	125	150	—
	Qe	ENTER LINE 8	x .025	x .029	x .028	x .027
17	σ_U	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	1.9	3.6	4.2	—
	U	ENTER LINE 2	1	1	1	1
18	σ	CO CONCENTRATION "IMAGINARY QUEUE"	1.9	3.6	4.2	—
19	σ	CO ($mg\ m^{-3}$) TOTAL	4.3	8.9	11.7	0.3
20	σ	CO CONCENTRATION (ppm)--TOTAL	3.7	7.7	10.2	0.2
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	σ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	σ''	CO CONCENTRATION AT HEIGHT z (ppm)				

21.3

INDICATE

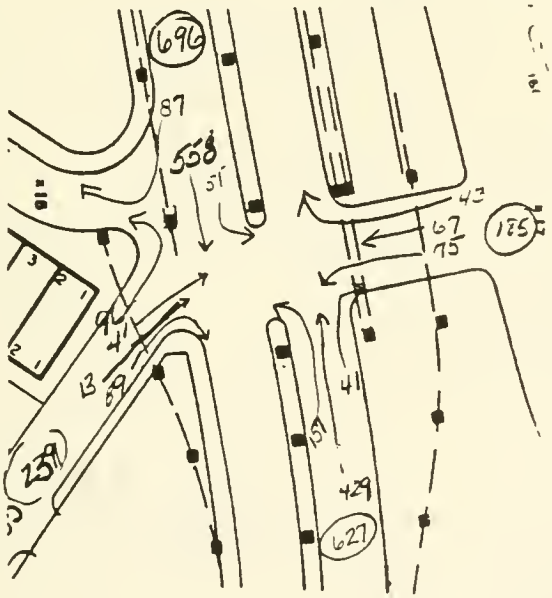
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED



TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM

ϕ_1 157 429 41

ϕ_2 87 508 51 429 41

ϕ_3 18 second pedestrian actuated

ϕ_4 96 41 13 139 43 67 75

Project Title

GEOMETRIC SKETCH PLAN

Drawing Title

INTERSECTION 1 1982 8-HOUR NO BUILD

Project Number

Drawing Number

Drawn By RL

Scale

Date 6/20/82

Sasaki Associates, Inc.

64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CKD. RL 6/29/82

CAPACITY ANALYSIS
WORK SHEET 1982 3-HOUR NO BUILD

PROJECT
INTERSECTION 1
8-HOUR
AM / PM (EXIST) / PROP.

SHEET 1 OF
FILE NO.
DATE
COMP. BY
CHECKED BY

GENERAL DESCRIPTION

STREET NAME & DIRECTION		Comm NB	U.A. SB	UA NB	Comm W	
MOVEMENTS		L-S-R	L-S-R	L-S-R	L-S-R	
PHASE		4	2	1 & 2	4	

PHYSICAL CONDITIONS

PARKING WITHIN 250'	NO · 1 · (2)	NO · (1) · 2	NO · (1) 2	(NO) · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY	1	1	1	1	
APPROACH or LANE WIDTH	32'	36'	36'	24'	

STANDARD APPROACHES

LOCATION: (CBD) F-OBD-R		6.7		6.6		6.6		6.5			
AREA FACTOR	fa		1.00		1.00		1.00		1.00		
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07	.85	1.07		

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPs)		I7									
L or R LOW TYP. (SEP o)		I8-A									
L or R HIGH TYP. (SEP o)		I8-B									
DBL. L or R H.T. (SEP o)		I8-D									
"T" or "Y" (INCL. CASE TYPE)		F-I3									
SPECIAL "T" (OPTION LANE)		F-I2	V'=		V'=		V'=		V'=		V'=
LEFT TURN ADVANCE GREEN		F-I0									
OTHER (SPECIFY)											
FOR I8-D & F-I3 ONLY	TURNING ANGEL	f_Δ									
	ENT. WIDTH	fwe									

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95	10	.95		
% LEFT TURNS	fl	33	1.00	8	1.005	25	.985	41	.90		
% RIGHT TURNS	fr	48	1.00	13	0.995	7	1.005	23	.93		
NO. BUSSES / HOUR	fb	—	—	—	—	—	—	—	—		
INTERMEDIATE FACTOR Fi = fa · fpphf · fa · fwe · ft · fl · fr · fb		1.02		1.02		1.01		0.85			

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4			4					
CYCLE LENGTH (SEC.)		C	79			79			79			79					
DESIGN	RATIO	Y/C	.05			.05			.05			.05					
	INT. S.V., DESIGN (SV · Fi)	ISV	1450	1479		2160	2203		2160	2121		1950	1658				
	DESIGN HOUR VOLUME	DHV	239			696			627			185					
	DESIGN G/C = DHV / ISV	DG/C	.16			.32			.288			.112					

LEVEL OF SERVICE DETERMINATION ΣY/C + ΣDG/C = LOS =

ANALYSIS OF SERVICE LEVELS			(A)	B	C	(A)	B	C	(A)	B	C	(A)	B	C			
ANALYSIS	GREEN INTERVAL (SEC)	G	18			33			40			18					
	RATIO	G/C	.23			.42			.51			.23					
	COMPOSITE FACTOR fi · G/C	fc	.23			.43			.51			.20					
	CHART SERVICE VOLUME	CSV	1230	1300	1450	1920	2010	2160	1720	2010	2160	1830	1890	1950			
	ACTUAL SERVICE VOLUME	ASV	283	299		826			982			362					
	PEAK HOUR VOLUME	PHV	239			696			627			185					

COMMENTS

rgm 7-802

Intersection 1

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following) 1982 2-HOUR NO BUILD

Project No.: 2026.01 Analyst: R. Loxley

Site: Marketplace Center Date: 6/25/82

CKD RL 6/29/82

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CommN	UASB	UANB	CommW
2	V_i	Demand volume (vph)	239	696	627	185
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)	.038	.038	.038	.038
6.1	M_i	Number of lanes in approach i	3	3	3	2
6.2	j	Signalized intersections phase identification	4	2	1&2	4
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1230	1920	1920	1850
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	239	696	627	185
6.5	C_y	Signal cycle length (s)	79			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	18	33	40	18
6.7	C_i	Capacity of approach i (vph)	416	1096	1300	444
6.8	$P_{i,j}$	Proportion of vehicles that stop	1.0	0.9	0.7	0.9
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	5	14	10	4
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.4	1.7	0.9	0.7
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	17	42	29	19
9	Rq_i	Average excess running time on approach (s/veh)	43	26	16	33
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.11	.11	.11	.11
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.04	.04	.04	.04
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.009	.027	.019	.008
13	Lad_i	Length of acceleration and deceleration (m)	56	56	56	56
14	Le_i	Length over which excess emissions apply (m)	40	40	40	40
15	Fs_i	Average idling emission rate (g/s)	0.45	0.72	0.34	0.26
16	Qe	Average excess emission rate (g/m-s)	.024	.056	.035	.018
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.022	.049	.030	.016
18	Qfc_i	Free-flow emission rate (g/s-m)	.002	.007	.007	.002

17a	.024	.056	.035	.018
17b	.002	.007	.005	.002

0°

INTERSECTION 1 RECEPTOR 1

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

1982 3-HOUR NO RUN

PROJECT NO.: 2026.01 ANALYST: R. Langley

SITE Marketplace Center DATE: 6/25/82 CKD RL 6/29/82

LINE NO	SYMBOL	INPUT/UNITS	CommN	UAse	UA,E	Comm W
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED (m s^{-1})	3	3	3	3
3	ϕ	WIND ROAD ANGLE (deg)	5°	45°	49°	40°
4	x	LATERAL DISTANCE (m)	9	62	76	41
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	82	115	33	122
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	21	73	21	101
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE (g m^{-1} s^{-1})	.022	.049	.030	.016
9	Qf	FREE FLOW EMISSIONS RATE (g m^{-1} s^{-1})	.002	.007	.007	.002
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	χU^{-1}	NORMALIZED CONCENTRATION (10^{-3} m^{-1}) FREE FLOW	810	130	120	170
	Qf	ENTER LINE 9	x .002	x .007	x .007	x .002
11	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	1.6	0.9	0.8	0.3
	U	ENTER LINE 2	3	3	3	3
12	χ	CO CONCENTRATION (mg m^{-3}) THROUGH EMISSIONS	0.5	0.3	0.3	0.1
13	χU^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	175	100	—	175
	Qe	ENTER LINE 8	.022	.049	.030	.016
14	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	3.8	4.9	—	2.8
	U	ENTER LINE 2	3	3	3	3
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	1.3	1.6	—	0.9
16	χU^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	110	62	—	175
	Qe	ENTER LINE 8	x .022	x .049	x .030	x .016
17	χU	NORMALIZED CONCENTRATION (mg m^{-1} s^{-1})	2.4	3.0	—	2.8
	U	ENTER LINE 2	3	3	3	3
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	0.8	1.0	—	0.9
19	χ	CO (mg m^{-3}) TOTAL	2.6	2.9	0.3	1.9
20	χ	CO CONCENTRATION (ppm)--TOTAL	2.3	2.5	0.3	1.6
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

6.7

270°

INTERSECTION / RECEPTOR 2

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

1982 8-HOUR
NO BUILD

PROJECT NO. 2026.01 ANALYST K. L

SITE. Marketplace Center DATE 6/25/82 OKD RL 6/29/82

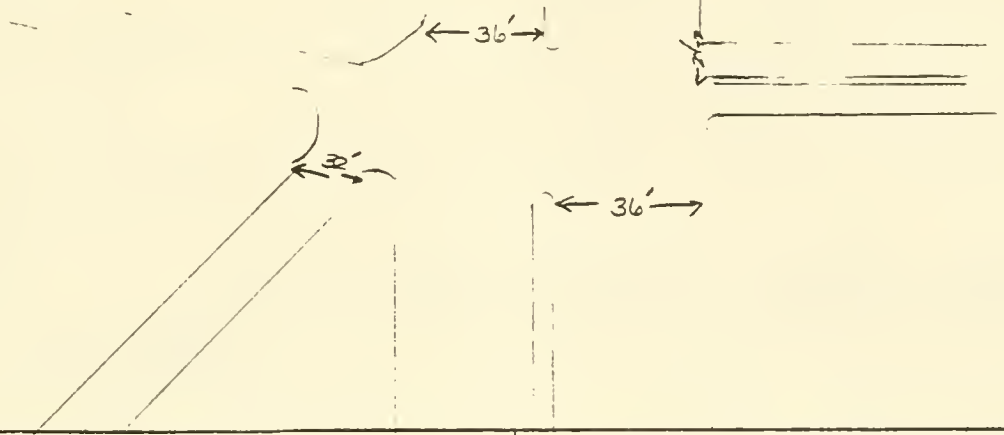
LINE NO	SYMBOL	INPUT UNITS	COMMN	UASE	LAUB	COMMW
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	3
3		WIND ROAD ANGLE (deg)	87	40		52
4	x	LATERAL DISTANCE (m)	149	52	43	146
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	72	209	152	55
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	58	171	126	38
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.022	.049	.030	.016
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.002	.007	.007	.002
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	$\lambda U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	70	150	160	70
	Q'	ENTER LINE 9	x .002	x .007	x .007	x .002
11	λU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.1	1.0	1.1	0.1
	U	ENTER LINE 2	3	3	3	3
12	λ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.1	0.4	0.4	0.05
13	λUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	75	135	175	—
	Qe	ENTER LINE 8	.022	.049	.030	.016
14	λU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.6	6.6	5.2	—
	U	ENTER LINE 2	3	3	3	3
15	λ	CO CONCENTRATION--"MAXIMUM QUEUE"	0.6	2.2	1.8	—
16	λUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	75	125	175	—
	Qe	ENTER LINE 8	x .022	x .049	x .030	x .016
17	λU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	1.6	6.1	5.2	—
	U	ENTER LINE 2	3	3	3	3
18	λ	CO CONCENTRATION--"IMAGINARY QUEUE"	0.6	2.0	1.8	—
19	λ	CO ($mg\ m^{-3}$) TOTAL	1.3	4.6	4.0	.05
20	λ	CO CONCENTRATION (ppm) TOTAL	1.1	4.0	3.5	.04
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	λ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	λ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8.6

INDICATE

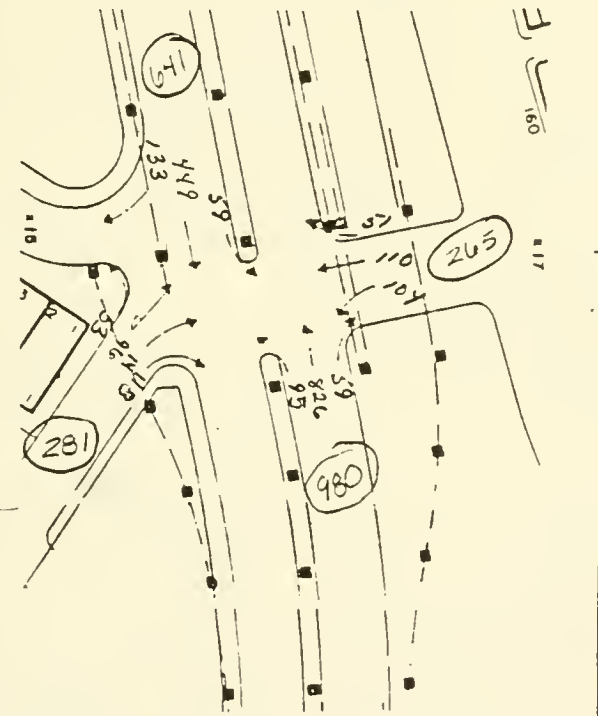
Right of way
Pavement widtha
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking reatrictiona

EXISTING/PROPOSED



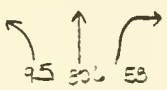
TRAFFIC VOLUMES

Date _____

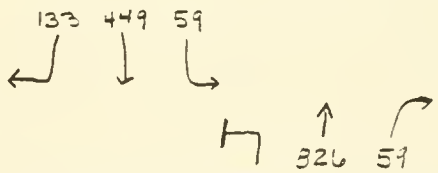


SIGNAL PHASING DIAGRAM

ϕ_1

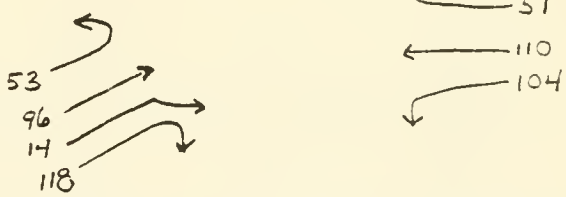


ϕ_2



ϕ_3 18 second pedestrian (actuated)

ϕ_4



Project Title
GEOMETRIC SKETCH PLAN

Project Number

Drawn By

Drawing Title
INTERSECTION 1 1987 1-HOUR NO BUILD

Drawing Number

Scale

Date

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS WORK SHEET 1987 1-HOUR NO BUILD

PROJECT _____
INTERSECTION 1
AM/(PM) EXIST/(PROP.)

SHEET NO. ___ of ___
FILE NO. _____
DATE _____
COMP. BY _____
CHECKED BY _____

GENERAL DESCRIPTION

STREET NAME & DIRECTION		Comm NE	U.A SB	U.A NB	Comm NW	
MOVEMENTS		L-S-R	L-S-R	L-S-R	L-S-R	
PHASE		4	2	1 & 2	4	

PHYSICAL CONDITIONS

PARKING WITHIN 250'		NO · 1 · (2)	NO · (1) · 2	NO · (1) · 2	(NO) · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY		1	1	1	1	
APPROACH or LANE WIDTH		32'	36'	36'	24'	

STANDARD APPROACHES

LOCATION: C8D-F-08D-R		6.7		6.6		6.6		6.5		
AREA FACTOR	fa		1.00		1.00		1.00		1.00	
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07	.85	1.07	

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPs)	I7									
L or R LOW TYP. (SEP o)	I8-A									
L or R HIGH TYP. (SEP o)	I8-B									
DBL. L or R H.T. (SEP o)	I8-D									
"T" or "Y" (INCL. CASE TYPE)	F-13									
SPECIAL "T" (OPTION LANE)	F-12	V'=		V'=		V'=		V'=		V'=
LEFT TURN ADVANCE GREEN	F-10									
OTHER (SPECIFY)										
FOR I8-D & F-13 ONLY	TURNING ANGEL fΔ									
	ENT. WIDTH fwe									

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	0.95	10	0.95	10	0.95	10	0.95	
% LEFT TURNS	fl	42	1.00	21	0.98	6	1.01	19	0.93	
% RIGHT TURNS	fr	52	1.00	9	1.00	10	1.00	39	0.90	
NO. BUSSES / HOUR	fb	—	—	—	—	—	—	—	—	
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.02		1.00		1.03		0.85		

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4			4				
CYCLE LENGTH (SEC.)		C	100			100			100			100				
DESIGN	RATIO	Y/C	.04			.04			.04			.04				
	INT. S.V., DESIGN (SV·Fi)	ISV	1450	1479		2160	2160		2160	2221		1653	1653			
	DESIGN HOUR VOLUME	DHV	281			641			980			265				
	DESIGN G/C = DHV / ISV	DG/C	.19			.30			.44			.16				
LEVEL OF SERVICE DETERMINATION			ΣY/C + ΣDG/C =									LOS =				
ANALYSIS OF SERVICE LEVELS			A	B	(C)	(A)	B	C	(A)	B	C	(A)	B	C		
ANALYSIS	GREEN INTERVAL (SEC)	G	20			53			59			20				
	RATIO	G/C	.2			.53			.59			.2				
	COMPOSITE FACTOR fi·G/C	fc	.2			.53			.61			.17				
	CHART SERVICE VOLUME	CSV	1290	1320	1520	1920	2010	2160	1920	2010	1920	1250	1990	1050		
	ACTUAL SERVICE VOLUME	ASV	252	276	336	1015	1145	1145	1166	1221	1310	314	321	353		
	PEAK HOUR VOLUME	PHV	281	281	281	641			980			265				

COMMENTS

rgm 7·80

Intersection 1 1987 1-Hour

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following) No Build

Project No.: 2[illegible]31 Analyst: R. Lexsley

Site: Marketplace Center Date: 6/17/82 CKD R. 6/29/82

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	COMM N	UA SB	UA NB	Comm W
2	V_i	Demand volume (vph)	281	641	980	265
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	15	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)	.058	.039	.039	.039 *
6.1	M_i	Number of lanes in approach i	3	3	3	2
6.2	j	Signalized intersections phase identification	4	2	1&2	4
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1530	1920	1920	1850
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	281	641	980	265
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	20	53	59	20
6.7	C_i	Capacity of approach i (vph)	362	1352	1556	377
6.8	$P_{i,j}$	Proportion of vehicles that stop	1.0	0.7	0.8	0.9
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	8	13	22	7
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	3	0.9	1.7	2.4
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	29	37	63	38
9	Rq_i	Average excess running time on approach (s/veh)	70	19	20	59
10	Ea_i	Excess emissions from acceleration (g/veh-m)	0.17	0.11	0.11	0.11
11	Ed_i	Excess emissions from deceleration (g/veh-m)	0.06	0.04	0.04	0.04
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	0.018	0.020	0.033	0.010
13	Lad_i	Length of acceleration and deceleration (m)	20	56	56	56
14	Le_i	Length over which excess emissions apply (m)	40	40	63	40
15	Fs_i	Average idling emission rate (g/s)	0.60	0.29	0.47	0.46
16	Oe	Average excess emission rate (g/m-s)	0.024	0.035	0.037	0.026
17	Oe'_i	Adjusted excess emission rate (g/s-m)	.019	.030	.028	.023
18	Qfc_i	Free-flow emission rate (g/s-m)	.004	.007	.011	.003

17a 49 .024 .035 .037 .026

17b .005 .005 .009 .003

Intersection 1 Receptor 1 1997 1-Hour
No Build

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO. 2026.01 ANALYST R. Longley
SITE Marketplace Center DATE: 6/18/92

LINE NO	SYMBOL	INPUT/UNITS	Comm N	UA EB	TRAFFIC STREAM UA NB	Comm W
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED (m s^{-1})	1	1	1	1
3	θ	WIND ROAD ANGLE (deg)	5°	45°	49°	40°
4	x	LATERAL DISTANCE (m)	9	62	76	41
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	82	102	53	142
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	49	73	0	101
7	z_o	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE (g m^{-1} s^{-1})	.019	.030	.028	.023
9	Qf	FREE FLOW EMISSIONS RATE (g m^{-1} s^{-1})	.004	.007	.011	.003
10		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	χ/Q^{-1}	NORMALIZED CONCENTRATION (10^{-3} m^{-1}) FREE FLOW	810	140	120	160
	Qf	ENTER LINE 9	x 0.004	x .007	x .011	x .003
11	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	3.2	1.0	1.3	0.5
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷ 1
12	χ	CO CONCENTRATION (mg m^{-3}) THROUGH EMISSIONS	3.2	1.0	1.3	0.5
13	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	175	105	—	175
	Qe	ENTER LINE 8	.019	.030	.028	.023
14	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	3.3	3.2	—	4.0
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷ 1
15	χ	CO CONCENTRATION - "MAXIMUM QUEUE"	3.3	3.2	—	4.0
16	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	50	62	—	175
	Qe	ENTER LINE 8	x .019	x .03	x .028	x .023
17	χU	NORMALIZED CONCENTRATION (mg m^{-1} s^{-1})	1.0	1.9	—	4.0
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷ 1
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	1.0	1.9	—	4.0
19	χ	CO mg m^{-3} TOTAL	7.5	6.1	1.3	8.5
20	χ	CO CONCENTRATION (ppm) -TOTAL	6.5	5.3	1.1	7.4
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

20.3

270°

Intersection 1 Receptor 2 1985 1-Hour No Build

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS

(see instructions following)

PROJECT NO.: 2026.01 ANALYST K. Tsiey

SITE Marriott's Hotel Center DATE: 3/15/82

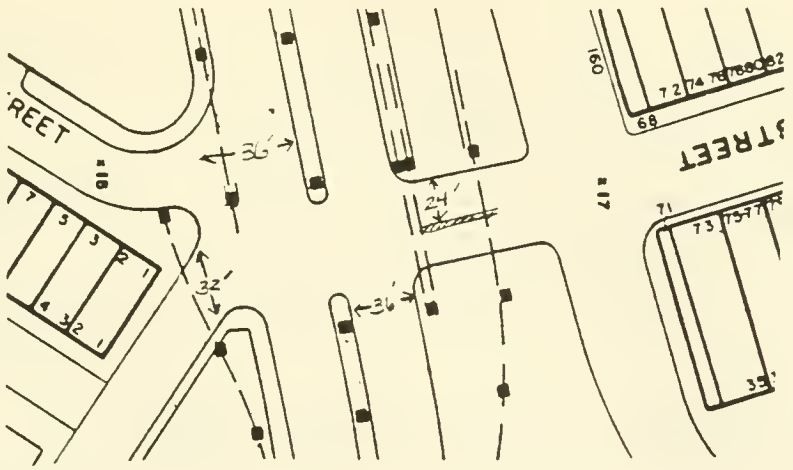
LINE NO	SYMBOL	INPUT/UNITS	TRAFFIC STREAM Comm N	UA SB	UA NB	Comm S
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	1
3	θ	WIND ROAD ANGLE (deg)	37	40	41	52
4	x	LATERAL DISTANCE (m)	149	58	43	146
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	72	204	152	55
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	40	171	87	0
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.019	.030	.028	.023
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.004	.007	.011	.003
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	70	150	163	70
	Qf	ENTER LINE 9	x .004	x .007	x .011	x .003
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.2	1.0	1.8	0.2
	U	ENTER LINE 2	1	1	1	1
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.2	1.0	1.8	0.2
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	75	130	175	—
	Qe	ENTER LINE 8	.019	.030	.028	.023
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.4	3.9	4.9	—
	U	ENTER LINE 2	1	1	1	1
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	1.4	3.9	4.9	—
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	75	125	150	—
	Qe	ENTER LINE 8	x .019	x .03	x .028	x .023
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	1.4	3.8	4.2	—
	U	ENTER LINE 2	1	1	1	1
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	1.4	3.8	4.2	—
19	χ	CO ($mg\ m^{-3}$) TOTAL	3.0	8.7	10.9	0.2
20	χ	CO CONCENTRATION (ppm)--TOTAL	2.6	7.6	9.5	0.2
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

19.9

INDICATE

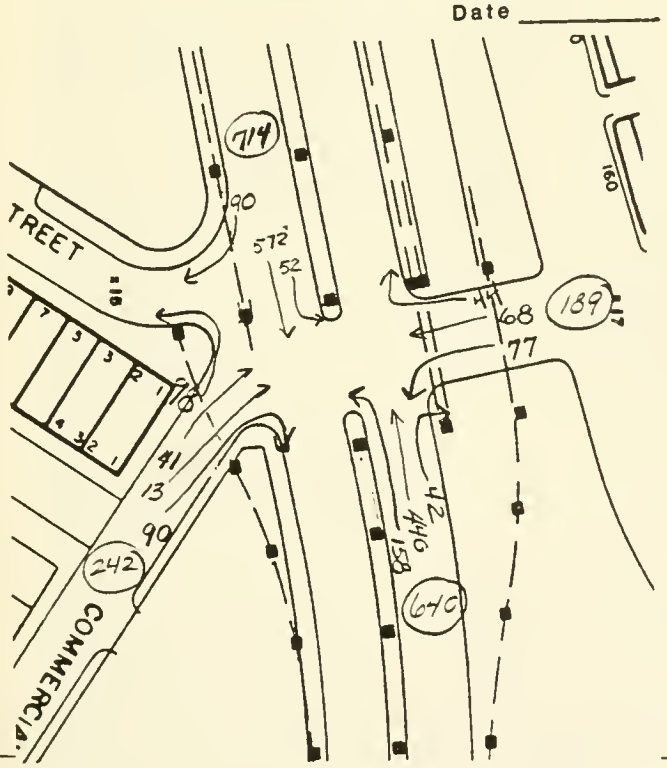
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED

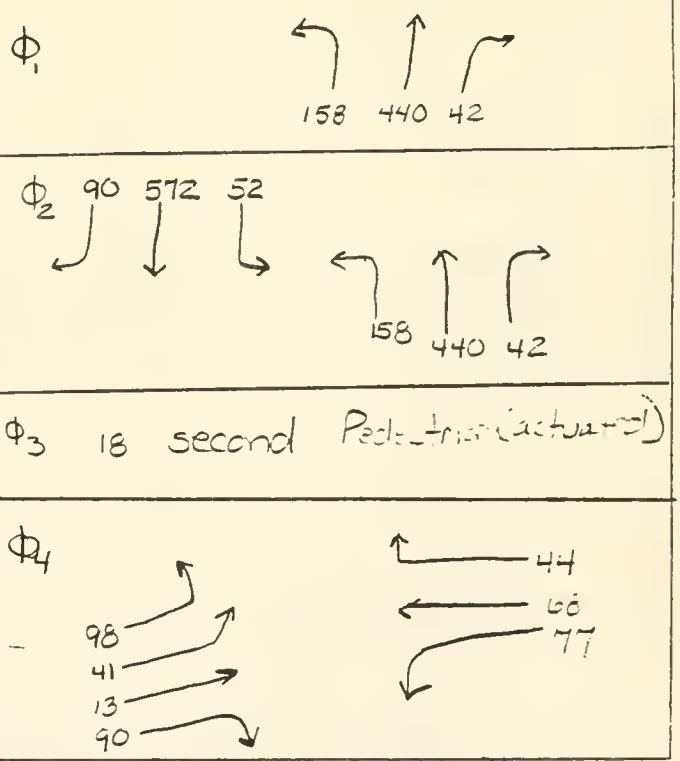


TRAFFIC VOLUMES

Date



SIGNAL PHASING DIAGRAM



KI

Project Title

GEOMETRIC SKETCH PLAN

Drawing Title

INTERSECTION 1 1987 8-HOUR NO BUILD

Project Number

Drawing Number

Drawn By

Scale

7/7/82

Date

Sasaki Associates, Inc.

64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS WORK SHEET 1977 8-HOUR NO BUILD

PROJECT _____
INTERSECTION 1
AM / (PM) EXIST / PROP

SHEET NO. ___ of ___
FILE NO. _____
DATE _____
COMP. BY _____
CHECKED BY _____

GENERAL DESCRIPTION

STREET NAME & DIRECTION	[illegible] NB	UA SE	UH NB	Comm W	
MOVEMENTS	L-S-R	L-S-R	L-S-R	L-S-R	
PHASE	4	2	2	4	

PHYSICAL CONDITIONS

PARKING WITHIN 250'	NO · 1 · (2)	NO · (1) · 2	NO · (1) · 2	(NO) · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY	1	1	1	1	
APPROACH or LANE WIDTH	32'	36'	36'	24'	

STANDARD APPROACHES

LOCATION: CBD-F-08D-R								
AREA FACTOR	fa	6.7	1.00	6.6	1.00	6.6	1.00	6.5	1.00		
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07	.85	1.07		

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPe)	I7									
L or R LOW TYP. (SEP o)	I8-A									
L or R HIGH TYP. (SEP o)	I8-B									
DBL. L or R H.T. (SEP o)	I8-D									
"T" or "Y" (INCL. CASE TYPE)	F-13									
SPECIAL "T" (OPTION LANE)	F-12	V'=		V'=		V'=		V'=		V'=
LEFT TURN ADVANCE GREEN	F-10									
OTHER (SPECIFY)										
FOR I8-D & F-13 ONLY: TURNING ANGEL	f_Δ									
FOR I8-D & F-13 ONLY: ENT. WIDTH	fwe									

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95	10	.95	
% LEFT TURNS	fl	40	1.00	7	1.03	25	.87	41	.90	
% RIGHT TURNS	fr	37	1.00	13	.995	7	1.00	23	.94	
NO. BUSSES / HOUR	fb	—	—	—	—	—	—	—	—	
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.02		1.04		.88		.86		

CALCULATIONS

CLEARANCE INTERVAL (SEC.)	Y	4		4		4		4							
CYCLE LENGTH (SEC.)	C	79		79		79		79							
DESIGN: RATIO	Y/C	.05		.05		.05		.05							
DESIGN: INT. S.V., DESIGN (SV·Fi)	ISV	1450	1479	2160	2246	2160	1901	1950	1677						
DESIGN: DESIGN HOUR VOLUME	DHV	242		714		640		189							
DESIGN: DESIGN G/C = DHV / ISV	DG/C	.16		.32		.34		.11							

LEVEL OF SERVICE DETERMINATION ΣY/C + ΣDG/C = LOS =

ANALYSIS OF SERVICE LEVELS		(A)	B	C	(A)	B	C	(A)	B	C	(A)	B	C			
ANALYSIS: GREEN INTERVAL (SEC)	G	18			33			40			18					
ANALYSIS: RATIO	G/C	.23			.42			.51			.23					
ANALYSIS: COMPOSITE FACTOR fi·G/C	fc	.23			.44			.45			.20					
ANALYSIS: CHART SERVICE VOLUME	CSV	1230	1300	1450	1920	2010	2160	1920	2010	2160	1850	1890	1950			
ANALYSIS: ACTUAL SERVICE VOLUME	ASV	282			845			864			370					
ANALYSIS: PEAK HOUR VOLUME	PHV	242			714			640			189					

COMMENTS

INTERSECTION 1

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 2026.01 Analyst: RL 1987 8-HOUR NO BUILD

Site: Marketplace Center Date: 7/7/32

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CommN	UAsb	UAnb	CommW
2	V_i	Demand volume (vph)	242	714	640	189
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)	.026	.026	.026	.026
6.1	M_i	Number of lanes in approach i	3	3	3	2
6.2	j	Signalized intersections phase identification	4	2	2+1	4
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1230	1920	1920	1850
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	242	714	640	189
6.5	C_y	Signal cycle length (s)	77			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	18	33	40	18
6.7	C_i	Capacity of approach i (vph)	411	1122	1148	444
6.8	$P_{i,j}$	Proportion of vehicles that stop	1	0.9	0.7	0.9
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	5	14	10	4
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.3	1.8	1.3	0.7
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	17	42	30	19
9	Rq_i	Average excess running time on approach (s/veh)	42	26	18	33
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.11	.11	.11	.11
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.04	.04	.04	.04
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.009	.027	.019	.008
13	Lad_i	Length of acceleration and deceleration (m)	56	56	56	56
14	Le_i	Length over which excess emissions apply (m)	40	42	40	40
15	Fs_i	Average idling emission rate (g/s)	.29	.48	.27	.17
16	Qe	Average excess emission rate (g/m-s)	.020	.047	.033	.015
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.018	.042	.030	.014
18	Qfc_i	Free-flow emission rate (g/s-m)	.002	.005	.005	.001

17a. .020 .047 .033 .015

17b. .002 .005 .003 .001

0°

INTERSECTION 1 RECEPTOR 1

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS 1987 8-HOUR NO BUILD

(see instructions following)

PROJECT NO.: 2026.01 ANALYST: RL

SITE: Marketplace Center DATE: 7/7/82

LINE NO	SYMBOL	INPUT/UNITS	CommN	UAse	UANB	Comm
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	3
3	ϕ	WIND ROAD ANGLE (deg)	5°	45	49	40
4	x	LATERAL DISTANCE (m)	9	62	76	41
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	82	114	53	120
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	61	73	23	101
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.018	.042	.030	.014
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.002	.005	.005	.001
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^3\ m^{-1}$) FREE FLOW	810	140	120	160
	Qf	ENTER LINE 9	x .002	x .005	x .005	x .001
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.6	0.7	0.6	0.16
	U	ENTER LINE 2	3	3	3	3
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.5	0.2	0.2	.05
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	175	75	—	175
	Qe	ENTER LINE 8	.018	.042	.030	.014
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	3.2	3.2	—	2.4
	U	ENTER LINE 2	3	3	3	3
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	1.0	1.0	—	0.8
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	100	62	—	175
	Qe	ENTER LINE 8	x .018	x .042	x .030	x .014
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	1.8	2.6	—	2.4
	U	ENTER LINE 2	3	3	3	3
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	0.6	0.9	—	0.8
19	χ	CO ($mg\ m^{-3}$) TOTAL	2.1	2.1	0.2	1.6
20	χ	CO CONCENTRATION (ppm)--TOTAL	1.8	1.8	0.2	1.4
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

5.2

270°

INTERSECTION 1 RECEPTOR 2

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS (see instructions following)

1987 3-HOUR NO BUILD

PROJECT NO. 2326.01 ANALYST RI

SITE Marketplace Center DATE 7/7/87

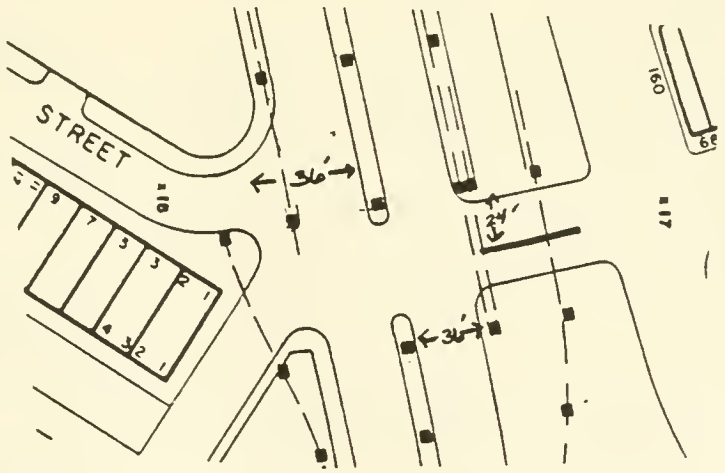
LINE NO	SYMBOL	INPUT UNITS	CmmN	UAsB	UAnB	CmmW
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	3
3	α	WIND ROAD ANGLE (deg)	37	40	41	52
4	x	LATERAL DISTANCE (m)	149	58	43	146
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	72	209	152	55
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	52	171	122	36
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.018	.042	.030	.014
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.002	.005	.005	.001
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	χ/Q^{-1}	NORMALIZED CONCENTRATION ($10^3\ m^{-1}$) FREE FLOW	70	150	160	70
	Qf	ENTER LINE 9	x .002	x .005	x .005	x .001
11	χ/U	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.1	0.8	0.8	.07
	U	ENTER LINE 2	3	3	3	3
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	.05	0.2	0.3	.02
13	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	75	135	175	—
	Qe	ENTER LINE 8	.018	.042	.030	.014
14	χ/U	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.4	5.7	5.2	—
	U	ENTER LINE 2	3	3	3	3
15	χ	CO CONCENTRATION "MAXIMUM QUEUE"	0.4	1.9	1.8	—
16	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	75	125	160	—
	Qe	ENTER LINE 8	x .018	x .042	x .030	x .014
17	χ/U	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	1.4	5.2	4.8	—
	U	ENTER LINE 2	3	3	3	3
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0.4	1.8	1.6	—
19	χ	CO ($mg\ m^{-3}$) TOTAL	0.8	3.9	3.7	.02
20	χ	CO CONCENTRATION (ppm) TOTAL	0.7	3.4	3.2	—
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

7.3

INDICATE

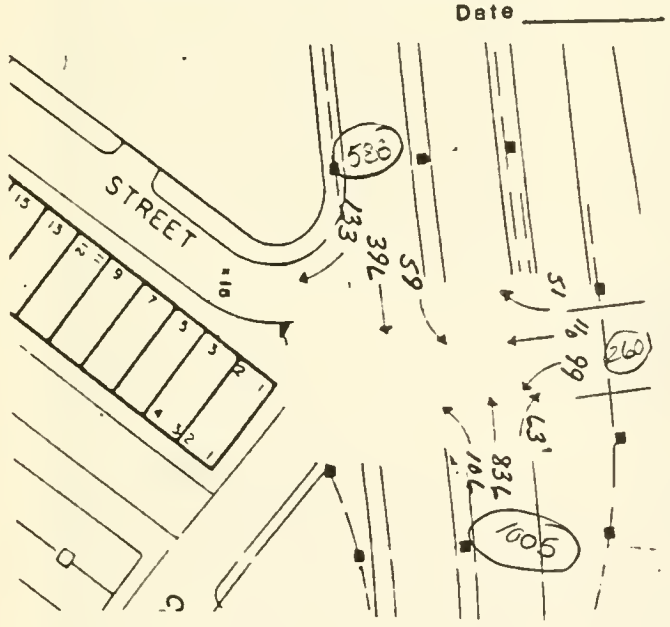
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED



TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM

Φ_1 106 836 63

Φ_2 133 396 59 106 836 63

Φ_3 18 second pedestrian phase

Φ_4 51 116 99

Project Title: GEOMETRIC SKETCH PLAN

Project Number:

Drawn By: KL

Drawing Title: INTERSECTION 1 1987 1-HOUR BUILD

Drawing Number:

Scale:

Date: 7/11/82

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS WORK SHEET 1987 1-HOUR BUILD

PROJECT _____
INTERSECTION 1
AM/(PM) EXIST/(PROP)

SHEET NO. ___ of ___
FILE NO. _____
DATE _____
COMP. BY _____
CHECKED BY _____

GENERAL DESCRIPTION

STREET NAME & DIRECTION		VA SB	UA NB	Comm W		
MOVEMENTS		R-S-L	R-S-L	R-L-S		
PHASE		2	1 & 2	4		

PHYSICAL CONDITIONS

PARKING WITHIN 250'		NO · (1) · 2	NO · (1) · 2	(NO) · 1 · 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY		1	1	1		
APPROACH or LANE WIDTH		36	36	24		

STANDARD APPROACHES

LOCATION: (CBD) F-OBD-R											
AREA FACTOR	fa	6.6	1.00	6.6	1.00	6.5	1.00				
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07				

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPs)	I7								
L or R LOW TYP. (SEP o)	I8-A								
L or R HIGH TYP. (SEP o)	I8-B								
DBL. L or R H.T. (SEP o)	I8-D								
"T" or "Y" (INCL. CASE TYPE)	F-I3								
SPECIAL "T" (OPTION LANE)	F-I2	V'=		V'=		V'=		V'=	V'=
LEFT TURN ADVANCE GREEN	F-I0								
OTHER (SPECIFY)									
FOR I8-D & F-I3 ONLY: TURNING ANGEL	f_Δ								
FOR I8-D & F-I3 ONLY: ENT. WIDTH	fwe								

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95				
% LEFT TURNS	fl	10	1.00	11	.99	38	.90				
% RIGHT TURNS	fr	23	.98	6	1.01	20	.95				
NO. BUSSES / HOUR	fb	—	—	—	—	—	-				
INTERMEDIATE FACTOR Fi = fo·fpphf·f_Δ·fwe·ft·fl·fr·fb		1.00		1.02		.87					

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4									
CYCLE LENGTH (SEC.)		C	100			100			100									
DESIGN	RATIO	Y/C	.04			.04			.04									
DESIGN	INT. S.V., DESIGN (SV·Fi)	ISV	2160	2160		2160	2203		1950	1695								
DESIGN	DESIGN HOUR VOLUME	DHV	588			1005			260									
DESIGN	DESIGN G/C = DHV / ISV	DG/C	.27			.46			.15									
LEVEL OF SERVICE DETERMINATION			ΣY/C + ΣDG/C =									LOS =						
ANALYSIS OF SERVICE LEVELS			(A)	B	C	(A)	B	C	(A)	B	C							
ANALYSIS	GREEN INTERVAL (SEC)	G	53			59			20									
ANALYSIS	RATIO	G/C	53			.59			.20									
ANALYSIS	COMPOSITE FACTOR fi·G/C	fc	.53			.60			.17									
ANALYSIS	CHART SERVICE VOLUME	CSV	1920	2010	2160	1920	2010	2160	1850	1890	1950							
ANALYSIS	ACTUAL SERVICE VOLUME	ASV	1018			1152			314									
ANALYSIS	PEAK HOUR VOLUME	PHV	588			1005			260									

COMMENTS

INTERSECTION 1

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following) 1987 1-HOUR BUILD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/1/82

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	USA SB	USA NB	State	
2	V_i	Demand volume (vph)	588	1005	260	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.039	.039	.039	
6.1	M_i	Number of lanes in approach i	3	3	2	
6.2	j	Signalized intersections phase identification	1	182	4	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1920	1920	1850	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	588	1005	260	
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	53	59	20	
6.7	C_i	Capacity of approach i (vph)	1352	1530	377	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.7	0.8	0.9	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	11	22	6	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.8	1.9	2.2	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	31	64	33	
9	Rq_i	Average excess running time on approach (s/veh)	19	21	57	
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.11	.11	.11	
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.04	.04	.04	
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.0165	.033	.009	
13	Lad_i	Length of acceleration and deceleration (m)	56	56	56	
14	Le_i	Length over which excess emissions apply (m)	40	64	40	
15	Fs_i	Average idling emission rate (g/s)	.265	.518	.436	
16	Qe	Average excess emission rate (g/m-s)	.030	.037	.024	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.026	.029	.022	
18	Qfc_i	Free-flow emission rate (g/s-m)	.006	.011	.003	

17a .030 .037 .024

.004 .008 .002

255°

INTERSECTION 1 RECEPTOR 2

WORKSHEET 5: INTERSECTION CO DISPERSION ANALYSIS (see instructions following) 1987 1-HOUR BUILD

PROJECT NO. 2026.01 ANALYST RL

SITE Marketplace Center DATE: 7/2/82 7/16/82

LINE NO	SYMBOL	INPUT UNITS	UA SB	UA NB	CommW	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	
3	ϕ	WIND ROAD ANGLE (deg)	25	26	37	
4	x	LATERAL DISTANCE (m)	58	43	146	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	201	152	55	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	171	90	–	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.026	.029	.022	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006	.011	.003	
9a		STREET CANYON? YES OR NO				
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	180	200	70	
	Qf	ENTER LINE 9	x .006	x .011	x .003	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.1	2.2	0.2	
	U	ENTER LINE 2	1	1	1	
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	1.1	2.2	0.2	
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	125	170	–	
	Qe	ENTER LINE 8	.026	.029	.022	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	3.2	5.5	–	
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	3.2	5.5	–	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	125	75	–	
	Qe	ENTER LINE 8	x .026	x .029	x .022	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	3.2	2.2	–	
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	3.2	2.2	–	
19	χ	CO ($mg\ m^{-3}$) TOTAL	7.6	9.9	0.2	
20	χ	CO CONCENTRATION (ppm)--TOTAL	6.6	8.6	0.2	15.4
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

0°

INTERSECTION 1 RECEPTOR 1

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: 2026.01 ANALYST: K.

SITE: Market & Corner DATE: 5-17-82

LINE NO	SYMBOL	INPUT/UNITS	TRAFFIC STREAM: UA SB			
		BASIC INPUTS				
1	SC	STABILITY CLASS	D			
2	U	WIND SPEED ($m\ s^{-1}$)	1			
3	θ	WIND-ROAD ANGLE (deg)	45°			
4	x	LATERAL DISTANCE (m)	62			
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	104			
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	73			
7	σ_{z_0}	INITIAL DISPERSION (m)	5			
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.026			
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006			
9a		STREET CANYON? YES OR NO	NO			
		DISPERSION ANALYSIS				
10	$\lambda U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	140			
	Qf	ENTER LINE 9	x .006	x	x	x
11	λU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.8			
	U	ENTER LINE 2	÷ 1	÷	÷	÷
12	λ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.8			
13	$\lambda U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	130			
	Qe	ENTER LINE 8	.026			
14	λU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	3.4			
	U	ENTER LINE 2	÷ 1	÷	÷	÷
15	λ	CO CONCENTRATION--"MAXIMUM QUEUE"	3.4			
16	$\lambda U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	125			
	Qe	ENTER LINE 8	x .026	x	x	x
17	λU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	3.2			
	U	ENTER LINE 2	÷ 1	÷	÷	÷
18	λ	CO CONCENTRATION--"IMAGINARY QUEUE"	3.2			
19	λ	CO ($mg\ m^{-3}$) TOTAL	7.4			
20	λ	CO CONCENTRATION (ppm)--TOTAL	6.4			
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	λ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	λ'	CO CONCENTRATION AT HEIGHT z (ppm)				

270°

INTERSECTION 1 RECEPTOR 2

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS

(see instructions following)

PROJECT NO. 2026.01 ANALYST: RL

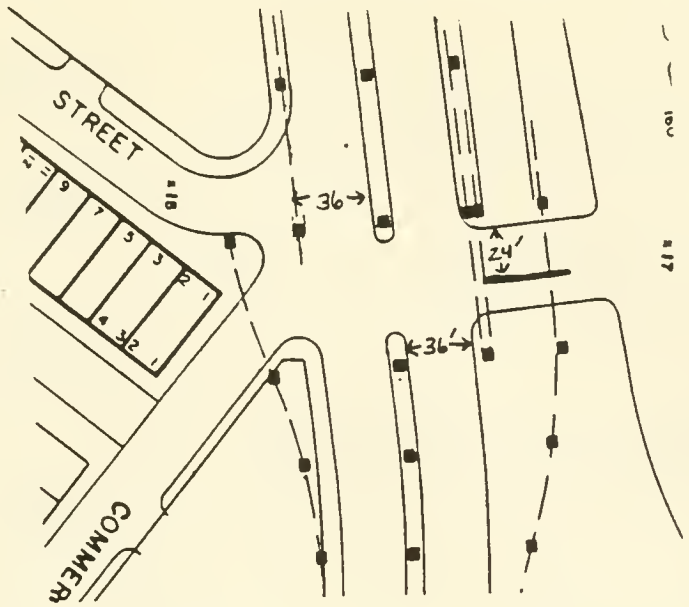
SITE Marketplace Center DATE: 7/7/82

LINE NO	SYMBOL	INPUT/UNITS	UA SB	UA NB	Comm W	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	
3	θ	WIND ROAD ANGLE (deg)	40	41	52	
4	x	LATERAL DISTANCE (m)	58	43	146	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	201	152	55	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	171	89	—	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.026	.029	.022	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006	.011	.003	
9a		STREET CANYON? YES OR NO				
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	150	160	70	
	Qf	ENTER LINE 9	x .006	x .011	x .003	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.9	1.8	0.2	
	U	ENTER LINE 2	1	1	1	
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.9	1.8	0.2	
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	130	175	—	
	Qe	ENTER LINE 8	.026	.029	.022	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	3.4	5.1	—	
	U	ENTER LINE 2	1	1	1	
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	3.4	5.1	—	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	125	150	—	
	Qe	ENTER LINE 8	x .026	x .029	x .022	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	3.2	4.4	—	
	U	ENTER LINE 2	1	1	1	
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	3.2	4.4	—	
19	χ	CO ($mg\ m^{-3}$) TOTAL	7.5	11.2	0.2	
20	χ	CO CONCENTRATION (ppm)--TOTAL	6.5	9.8	0.1	16.4
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

INDICATE

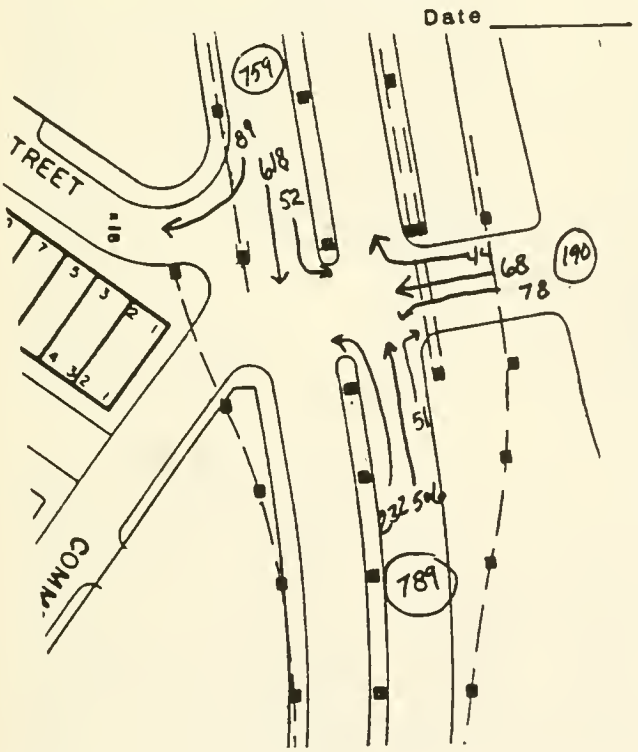
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED



TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM

Φ_1 232 506 51

Φ_2 89 618 52 232 506 51

Φ_3 18 second pedestrian (actuated)

Φ_4 44 68 78

Project Title: GEOMETRIC SKETCH PLAN

Project Number:

Drawn By: RL

Drawing Title: INTERSECTION 1 1987 8-HOUR BUILD

Drawing Number:

Scale:

Date: 7/12/82

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS
WORK SHEET 1987 8-HOUR BUILD

PROJECT
INTERSECTION 1
AM/PM EXIST / (PROP)

SHEET NO. ___ of ___
FILE NO.
DATE
COMP. BY
CHECKED BY

GENERAL DESCRIPTION

STREET NAME & DIRECTION		UA SB	UA NB	Comm W		
MOVEMENTS		L-S-R	L-S-R	L-S-R		
PHASE		2	2	4		

PHYSICAL CONDITIONS

PARKING WITHIN 250'		NO · (1) 2	NO (1) 2	(NO) 1 · 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY		1	1	1		
APPROACH or LANE WIDTH		36'	36'	24'		

STANDARD APPROACHES

LOCATION: CBD-F-OBD-R											
AREA FACTOR	fa	6.7	1.00	6.6	1.00	6.5	1.00				
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07				

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPe)	I7										
L or R LOW TYP. (SEP o)	I8-A										
L or R HIGH TYP. (SEP o)	I8-B										
DBL. L or R H.T. (SEP o)	I8-D										
"T" or "Y" (INCL. CASE TYPE)	F-13										
SPECIAL "T" (OPTION LANE)	F-12	V'=		V'=		V'=		V'=		V'=	
LEFT TURN ADVANCE GREEN	F-10										
OTHER (SPECIFY)											
FOR I8-D & F-13 ONLY: TURNING ANGEL	f_Δ										
FOR I8-D & F-13 ONLY: ENT. WIDTH	fwe										

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95				
% LEFT TURNS	fl	7	1.04	29	.86	41	.90				
% RIGHT TURNS	fr	12	.995	6	1.02	23	.94				
NO. BUSSES / HOUR	fb	—	—	—	—	—	—				
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.05		.89		.86					

CALCULATIONS

CLEARANCE INTERVAL (SEC.)	Y	4		4		4					
CYCLE LENGTH (SEC.)	C	79		79		79					
DESIGN: RATIO	Y/C	.05		.05		.05					
DESIGN: INT. S.V., DESIGN (SV·Fi)	ISV	2160	2268	2160	-	1950	1677				
DESIGN: DESIGN HOUR VOLUME	DHV	759		789		190					
DESIGN: DESIGN G/C = DHV / ISV	DG/C	.33		.41		.11					
LEVEL OF SERVICE DETERMINATION		ΣY/C + ΣDG/C =						LOS =			
ANALYSIS OF SERVICE LEVELS		(A)	B	C	(A)	B	C	(A)	B	C	
ANALYSIS: GREEN INTERVAL (SEC)	G	33			40			18			
ANALYSIS: RATIO	G/C	.42			.51			.23			
ANALYSIS: COMPOSITE FACTOR fi·G/C	fc	.44			.45			.20			
ANALYSIS: CHART SERVICE VOLUME	CSV	1920	2010	2160	1920	2010	2160	1850	1890	1950	
ANALYSIS: ACTUAL SERVICE VOLUME	ASV	642			864			362			
ANALYSIS: PEAK HOUR VOLUME	PHV	759			789			190			

COMMENTS

FUTURE SECTION 1

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following) 1997 8 HOUR BUILD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/12/97

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UASB	UANB	Comm'l	
2	V_i	Demand volume (vph)	759	789	190	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.026	.026	.026	
6.1	H_i	Number of lanes in approach i	3	3	2	
6.2	j	Signalized intersections phase identification	1	1&2	4	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1920	1920	1250	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	759	789	190	
6.5	C_y	Signal cycle length (s)	79			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	33	40	18	
6.7	C_i	Capacity of approach i (vph)	1122	1148	444	
6.8	$P_{i,j}$	Proportion of vehicles that stop	1.0	0.7	0.9	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	17	12	3.7	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	2.1	2.2	0.8	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	51	38	18	
9	Rq_i	Average excess running time on approach (s/veh)	30	20	34	
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.11	.11	.11	
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.04	.04	.04	
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.032	.023	.007	
13	Lad_i	Length of acceleration and deceleration (m)	56	56	56	
14	Le_i	Length over which excess emissions apply (m)	51	40	40	
15	Fs_i	Average idling emission rate (g/s)	.61	.38	.18	
16	Qe	Average excess emission rate (g/m-s)	.047	.041	.014	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.041	.037	.013	
18	Qfc_i	Free-flow emission rate (g/s-m)	.006	.005	.001	

17a .047 .041 .014

17b. .006 .004 .001

0°

INTERSECTION 1 Receptor 1

WORKSHEET 5: INTERSECTION CO DISPERSION ANALYSIS 1987 8 HOUR BUILD

(see instructions following)

PROJECT NO. 2026.01 ANALYST RL

SITE Marketplace Center DATE 7/12/82

LINE NO	SYMBOL	INPUT/UNITS	UASB			
		BASIC INPUTS				
1	SC	STABILITY CLASS	D			
2	U	WIND SPEED ($m\ s^{-1}$)	3			
3	ϕ	WIND ROAD ANGLE (deg)	45°			
4	x	LATERAL DISTANCE (m)	62			
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	124			
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	73			
7	σ_{z_0}	INITIAL DISPERSION (m)	5			
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.041			
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006			
9a		STREET CANYON? YES OR NO	NO			
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{3}\ m^{-1}$) FREE FLOW	140			
	Qf	ENTER LINE 9	x .006	x	x	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.8			
	U	ENTER LINE 2	3			
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.8			
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	140			
	Qe	ENTER LINE 8	.041			
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	5.7			
	U	ENTER LINE 2	3			
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	1.9			
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	125			
	Qe	ENTER LINE 8	x .041	x	x	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	5.1			
	U	ENTER LINE 2	3			
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	1.7			
19	χ	CO ($mg\ m^{-3}$) TOTAL	4.4			
20	χ	CO CONCENTRATION (ppm)--TOTAL	3.8			
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

270°

INTERSECTION 1 Receptor 2

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS 1987 3-HOUR
(see instructions following) REVISED

PROJECT NO.: 2026.01 ANALYST: RL

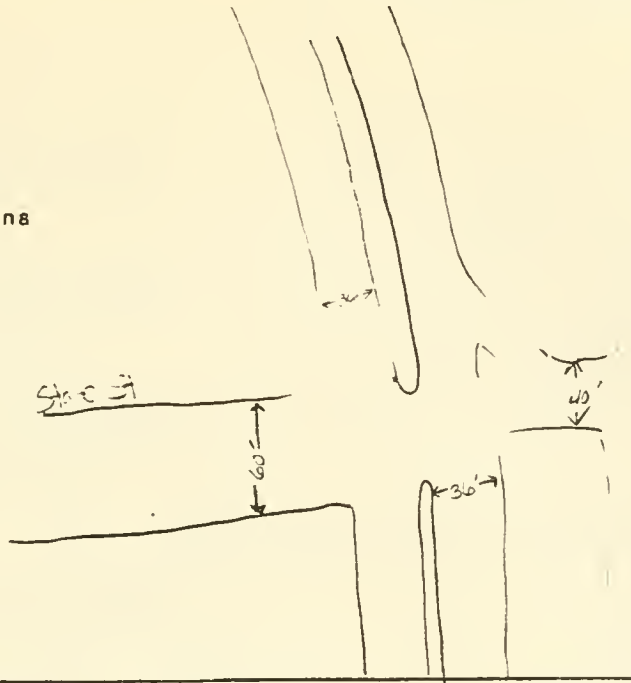
SITE Marketplace Center DATE: 7/12/92

LINE NO	SYMBOL	INPUT/UNITS	UASB	UA)...B	Comm(W)	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	
3	θ	WIND-ROAD ANGLE (deg)	40	41	52	
4	x	LATERAL DISTANCE (m)	58	43	146	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	222	152	55	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	171	114	37	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.041	.037	.013	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006	.005	.001	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	χ/Q^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	150	160	70	
	Qf	ENTER LINE 9	x .006	x .005	x .001	x
11	χ/U	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0.9	0.8	0.7	
	U	ENTER LINE 2	3	3	3	
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.3	0.2	0.02	
13	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	135	175	—	
	Qe	ENTER LINE 8	.041	.037	.013	
14	χ/U	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	5.5	6.4	—	
	U	ENTER LINE 2	3	3	3	
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	1.8	2.1	—	
16	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	120	175	—	
	Qe	ENTER LINE 8	x .041	x .037	x .013	x
17	χ/U	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	4.9	6.4	—	
	U	ENTER LINE 2	3	3	3	
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	1.6	2.1	—	
19	χ	CO ($mg\ m^{-3}$) TOTAL	3.7	4.7	0.02	
20	χ	CO CONCENTRATION (ppm)--TOTAL	3.2	3.8	—	7.0
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

INDICATE

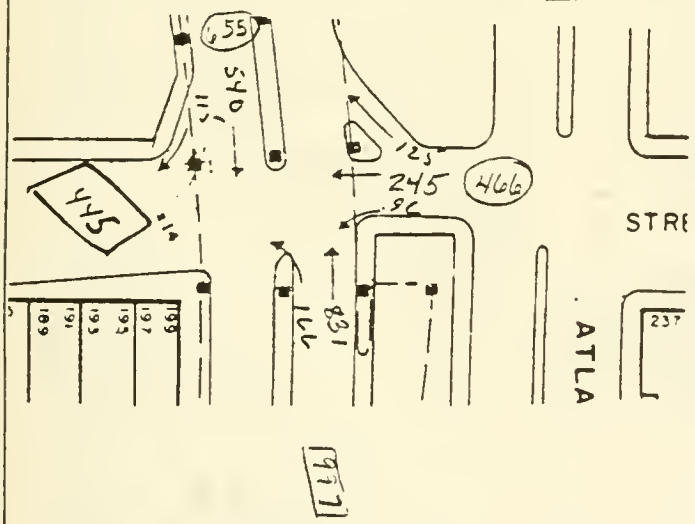
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED

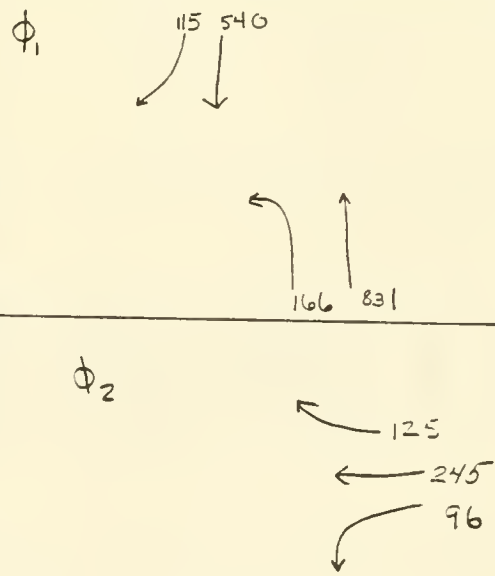


TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM


Φ1
115
540
166
831
Φ2
125
245
96

RL

Project Title | Project Number | Drawn By

GEOMETRIC SKETCH PLAN

Drawing Title | Drawing Number | Scale

1982 1-HOUR NO BUILD
INTERSECTION 2

Date

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CKD. RL 6/26/82

CAPACITY ANALYSIS 1-HOUR
WORK SHEET 1932 NO BUILD

PROJECT
INTERSECTION 2

AM/(PM) (EXIST)/ PROP

SHEET NO. ___ of ___
FILE NO.
DATE
COMP. BY
CHECKED BY RL

GENERAL DESCRIPTION

STREET NAME & DIRECTION	UA SB	UA NB	CT-MC		
MOVEMENTS	R-S	L-S	R-S-L		
PHASE	1	1	2		

PHYSICAL CONDITIONS

PARKING WITHIN 250'	NO · (1) · 2	NO · (1) · 2	(NO) · 1 · 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY	1	1	1		
APPROACH or LANE WIDTH	36'	36'	40'		

STANDARD APPROACHES

LOCATION: (CBD)-F-OBD-R												
AREA FACTOR	fa	6.6	1.00	6.6	1.00	6.5	1.00					
POP ≠ 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.80	1.07					

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPs)	I7											
L or R LOW TYP. (SEP o)	I8-A											
L or R HIGH TYP. (SEP o)	I8-B											
DBL. L or R H.T. (SEP o)	I8-D											
"T" or "Y" (INCL. CASE TYPE)	F-I3											
SPECIAL "T" (OPTION LANE)	F-I2	V'=		V'=		V'=		V'=		V'=		
LEFT TURN ADVANCE GREEN	F-I0											
OTHER (SPECIFY)												
FOR I8-D & F-I3 ONLY: TURNING ANGEL	f_Δ											
FOR I8-D & F-I3 ONLY: ENT. WIDTH	fwe											

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95					
% LEFT TURNS	fl	0	1.025	17	.985	25	.99					
% RIGHT TURNS	fr	18	.98	0	1.025	32	1.00					
NO. BUSSES / HOUR	fb	—	—	—	—	—	—					
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.02		1.03		1.01						

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4										
CYCLE LENGTH (SEC.)		C	100			100			100										
DESIGN	RATIO	Y/C	.04			.04			.04										
DESIGN	INT. S.V., DESIGN (SV·Fi)	ISV	2160	2203		2160			3340	3373									
DESIGN	DESIGN HOUR VOLUME	DHV	655			997			466										
DESIGN	DESIGN G/C = DHV / ISV	DG/C	.30			.45			.14										
LEVEL OF SERVICE DETERMINATION			ΣY/C + ΣDG/C = .66									LOS =							
ANALYSIS OF SERVICE LEVELS			(A)	B	C	C	(D)	E	(A)	B	C								
ANALYSIS	GREEN INTERVAL (SEC)	G	41			41			51										
ANALYSIS	RATIO	G/C	.41			.41			.51										
ANALYSIS	COMPOSITE FACTOR fi·G/C	fc	.42			.42			.52										
ANALYSIS	CHART SERVICE VOLUME	CSV	2160	2420	2550	2160	2420	2550	2340	2710	3340								
ANALYSIS	ACTUAL SERVICE VOLUME	ASV	907			907	1016	1071	1637										
ANALYSIS	PEAK HOUR VOLUME	PHV	655			997	997		466										

COMMENTS

rgm 7·80

INTERSECTION 2

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION 1992 1-40 AM
(see instructions following)

Project No.: 2226.01 Analyst: R. Ingley CKD. RL 6/20/92

Site: Marketplace Center Date: 6/15/92

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification	UA_{SB}	UA_{NB}	S_W	
2	V_i	Demand volume (vph)	655	997	466	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	10	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.059	.12	.059	
6.1	M_i	Number of lanes in approach i	3	3	3	
6.2	j	Signalized intersections phase identification	1	1	2	
6.3	$Cs_{i,j}$	Canacity service volume of approach i for phase j (vph of green)	2160	2420	3140	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	655	997	466	
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	41	41	51	
6.7	C_i	Capacity of approach i (vph)	1071	1071	1966	
6.8	$P_{i,j}$	Proportion of vehicles that stop	1.5	1	.6	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	21	28	8	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.6	14	.3	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	76	112	22	
9	Rq_i	Average excess running time on approach (s/veh)	50	77	15	
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.11	.24	.11	
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.04	.09	.04	
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.04	.092	.012	
13	Lad_i	Length of acceleration and deceleration (m)	56	9	56	
14	Le_i	Length over which excess emissions apply (m)	76	112	40	
15	Fs_i	Average idling emission rate (g/s)	1.5	3.7	.23	
16	Qe	Average excess emission rate (g/m-s)	.049	.041	.023	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.033	.007	.018	
18	Qfc_i	Free-flow emission rate (g/s-m)	.011	.033	.008	

17a. .049 .041 .023

17b. .016 .034 .005

135°

Intersection 2 Receptor 1 1982 1-HOUR NO BUILD

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO. 2026.01 ANALYST R. Longley
SITE Marketplace Center DATE: 6/16/82

LINE NO	SYMBOL	INPUT UNITS	UA SB	UA NB	TRAFFIC STREAM Site W	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	
3		WIND ROAD ANGLE (deg)	23	37	57	
4	x	LATERAL DISTANCE (m)	81	113	98	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	120	233	155	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	42	122	130	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.033	.007	.018	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.011	.033	.008	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	180	120	95	
	Qf	ENTER LINE 9	x .011	x .033	x .008	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	2.0	4.0	0.8	
	U	ENTER LINE 2	1	1	1	
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	2.0	4.0	0.8	
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	—	130	110	
	Qe	ENTER LINE 8	.033	.007	.018	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	0.9	2.0	
	U	ENTER LINE 2	1	1	1	
15	χ	CO CONCENTRATION - "MAXIMUM QUEUE"	—	0.9	2.0	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	—	50	110	
	Qe	ENTER LINE 8	x .033	x .007	x .018	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	0.4	2.0	
	U	ENTER LINE 2	1	1	1	
18	χ	CO CONCENTRATION - "IMAGINARY QUEUE"	—	0.4	2.0	
19	χ	CO ($mg\ m^{-3}$) TOTAL	2.0	5.3	4.8	
20	χ	CO CONCENTRATION (ppm) - TOTAL	1.8	4.6	4.2	10.6
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ	CO CONCENTRATION AT HEIGHT z (ppm)				

120°

Intersection 2 Receptor 2 1992 1-HOUR NO BUILD

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO. 2026.01 ANALYST R. Langley
SITE Marketplace Center DATE 6/15/22

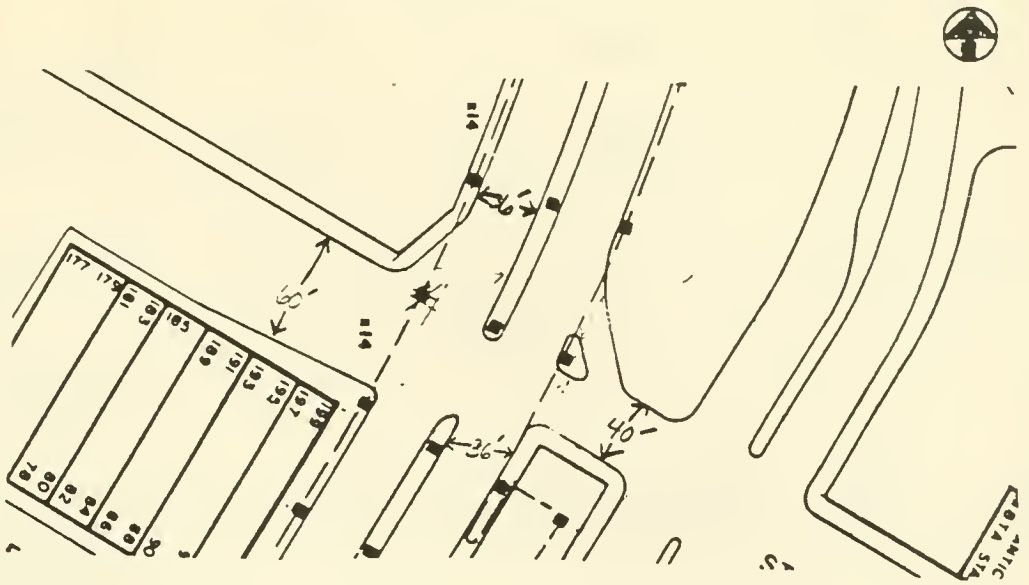
LINE NO.	SYMBOL	INPUT UNITS	TRAFFIC STREAM: UA SE	UA NE	UA NW	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	
3	θ	WIND ROAD ANGLE (deg)	20	10	84	
4	x	LATERAL DISTANCE (m)	76	45	91	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	94	233	72	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	—	122	38	
7	z_o	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.033	.007	.018	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.011	.033	.008	
33		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	χUQ	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	195	320	90	
	Qf	ENTER LINE 9	× .011	× .033	× .008	×
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	2.2	10.6	0.7	
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	2.2	10.6	0.7	
13	χUQ	NORMALIZED CONCENTRATION (FOR Yu)	—	125	100	
	Qe	ENTER LINE 8	.033	.007	.018	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	0.9	1.8	
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	—	0.9	1.8	
16	χUQ	NORMALIZED CONCENTRATION (FOR Yd)	—	—	75	
	Qe	ENTER LINE 8	× .033	× .007	× .018	×
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	—	1.4	
	U	ENTER LINE 2	÷ 1	÷ 1	÷ 1	÷
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	—	—	1.4	
19	χ	CO ($mg\ m^{-3}$) TOTAL	2.2	11.5	3.9	
20	χ	CO CONCENTRATION (ppm) TOTAL	1.9	10.0	3.4	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

15.3

INDICATE

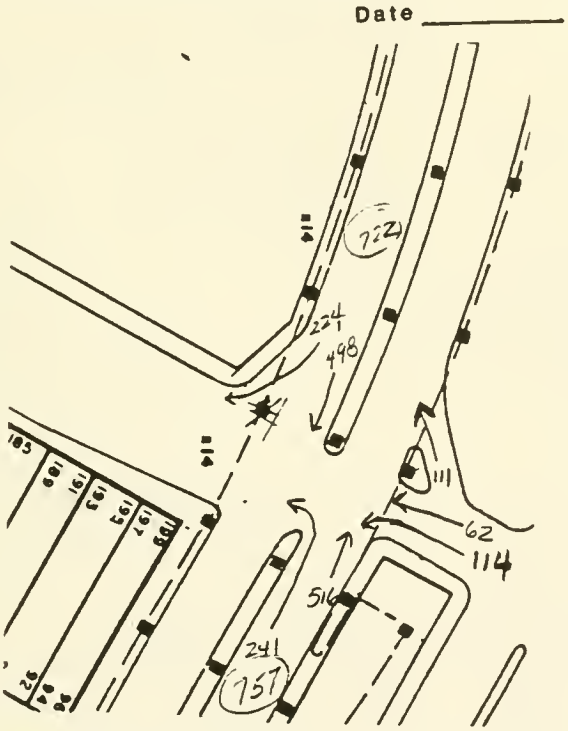
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED

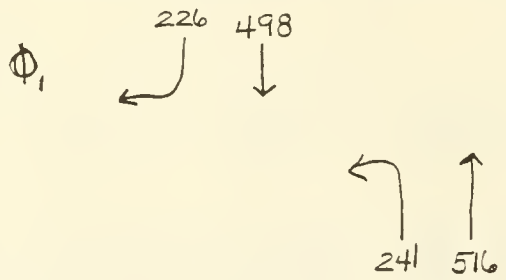


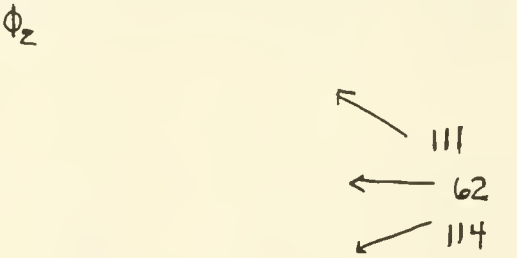
TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM





Project Title: GEOMETRIC SKETCH PLAN

Project Number:

Drawn By:

Drawing Title: 1982 8-HOUR NO BUILD

Drawing Number:

Scale:

Date:

Sasaki Associates, Inc.

64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS WORK SHEET

1982 3-HOUR NO BUILD

PROJECT
INTERSECTION 2
AM/PM (EXIST)/ PROP

SHEET NO. ___ of ___
FILE NO. ___
DATE ___
COMP. BY ___
CHECKED BY ___

GENERAL DESCRIPTION

STREET NAME & DIRECTION		UA SB	UA NB	State W		
MOVEMENTS		R-S	L-S	R-S-L		
PHASE		1	1	2		

PHYSICAL CONDITIONS

PARKING WITHIN 250'		NO · (1) · 2	NO · (1) · 2	(NO) · 1 · 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY		1	1	1		
APPROACH or LANE WIDTH		36'	36'	40		

STANDARD APPROACHES

LOCATION: (CBD)-F-OBD-R											
AREA FACTOR	fa	6.6	1.00	6.6	1.00	6.5	1.00				
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07				

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPs)	I7								
L or R LOW TYP. (SEP o)	I8-A								
L or R HIGH TYP. (SEP o)	I8-B								
DBL. L or R H.T. (SEP o)	I8-D								
"T" or "Y" (INCL. CASE TYPE)	F-I3								
SPECIAL "T" (OPTION LANE)	F-I2	V'=		V'=		V'=		V'=	V'=
LEFT TURN ADVANCE GREEN	F-I0								
OTHER (SPECIFY)									
FOR I8-D & F-I3 ONLY: TURNING ANGEL	f_Δ								
FOR I8-D & F-I3 ONLY: ENT. WIDTH	fwe								

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95				
% LEFT TURNS	fl	0	1.025	32	1.00	40	1.00				
% RIGHT TURNS	fr	31	1.00	0	1.025	39	1.00				
NO. BUSSES / HOUR	fb	—	—	—	—	—	—				
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.04		1.04		1.07					

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4								
CYCLE LENGTH (SEC.)		C	77			77			77								
DESIGN	RATIO	Y/C	.05			.05			.05								
DESIGN	INT. S.V., DESIGN (SV·Fi)	ISV	2160	2246		2160	2246		3340	3573							
DESIGN	DESIGN HOUR VOLUME	DHV	722			757			287								
DESIGN	DESIGN G/C = DHV / ISV	DG/C	.32			.34			.08								

LEVEL OF SERVICE DETERMINATION: Σ Y/C + Σ DG/C = 53 LOS =

ANALYSIS OF SERVICE LEVELS			A	(B)	C	B	(C)	D	(A)	B	C						
ANALYSIS	GREEN INTERVAL (SEC)	G	28			28			41								
ANALYSIS	RATIO	G/C	.36			.36			.53								
ANALYSIS	COMPOSITE FACTOR fi·G/C	fc	.37			.37			.22								
ANALYSIS	CHART SERVICE VOLUME	CSV	1920	2040	2160	2010	2160	2420	2140	3210	3340						
ANALYSIS	ACTUAL SERVICE VOLUME	ASV	719	744		743	799		690								
ANALYSIS	PEAK HOUR VOLUME	PHV	722			757			287								

COMMENTS

rgm 7·802

over →

INTERSECTION 2 1982 · 8-HOUR

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION NO BUILD
(see instructions following)

Project No.: 2020.01 Analyst: R. Langley

Site: Marketplace Center Date: 6/28/82

Step	Symbol	Input/Units					
1	i	Road segment (or approach identification)	USE	UANB	STAX		
2	V_i	Demand volume (vph)	722	757	287		
3	C_i	Free-flow capacity (vph)					
4	S_i	Cruise speed (mph)	20	15	25		
5	Ef_i	Free-flow emissions (g/veh-m)	.048	.059	.038		
6.1	M_i	Number of lanes in approach i	3	3	3		
6.2	j	Signalized intersections phase identification	1	1	2		
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2010	2160	3140		
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	722	757	287		
6.5	C_y	Signal cycle length (s)	77				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	28	28	41		
6.7	C_i	Capacity of approach i (vph)	944	944	832		
6.8	$P_{i,j}$	Proportion of vehicles that stop	1.0	1.0	.5		
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	15	16	3		
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	3.2	4.0	0.5		
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	48	53	9		
9	Rq_i	Average excess running time on approach (s/veh)	37	40	11		
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.13	.16	.11		
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.045	.06	.04		
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.034	.046	.006		
13	Lad_i	Length of acceleration and deceleration (m)	36	20	56		
14	Le_i	Length over which excess emissions apply (m)	48	53	40		
15	Fs_i	Average idling emission rate (g/s)	1.18	1.38	0.08		
16	Qe	Average excess emission rate (g/m-s)	.05	.04	.01		
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.041	.028	.008		
18	Qfc_i	Free-flow emission rate (g/s-m)	.010	.012	.003		
		17a	.05	.04	.01		
		17b	.009	.012	.002		

135°

INTERSECTION 2 RECEPTOR 1

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

1982 3-HOUR NO BUILD

PROJECT NO. 2026.01 ANALYST R.L.

SITE Marketplace Center DATE 6/28/82

LINE NO	SYMBOL	INPUT UNITS	UAsb	UAne	State	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	
3		WIND ROAD ANGLE (deg)	23°	37°	57°	
4	x	LATERAL DISTANCE (m)	81	113	98	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	122	177	141	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	88	122	130	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.040	.028	.008	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.010	.012	.003	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	180	120	95	
	Qf	ENTER LINE 9	x .010	x .012	x .003	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.8	1.4	0.3	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.6	0.5	0.1	
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	—	130	110	
	Qe	ENTER LINE 8	.040	.028	.008	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	3.6	0.9	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	
15	χ	CO CONCENTRATION "MAXIMUM QUEUE"	—	1.2	0.3	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	—	50	110	
	Qe	ENTER LINE 8	x .040	x .028	x .008	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	1.4	0.9	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	—	0.5	0.3	
19	χ	CO ($mg\ m^{-3}$) TOTAL	0.6	2.4	0.7	
20	χ	CO CONCENTRATION (ppm)--TOTAL	0.5	2.1	0.6	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

3.2

180°

Intersection 2 Receptor 2

1922 8-HOUR NO BUILD

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO. 2026.01 ANALYST R L

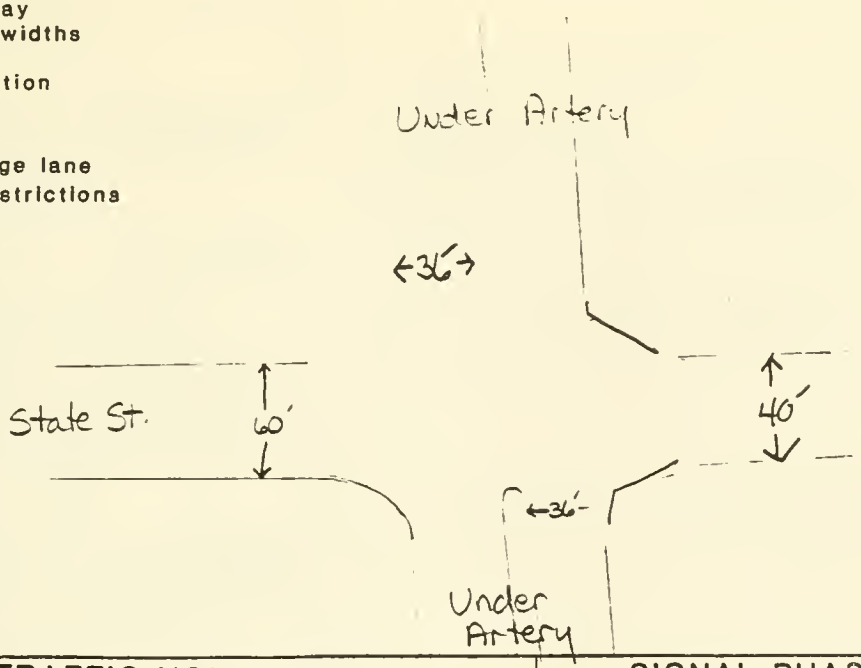
SITE Marketplace Center DATE 6/23/82

LINE NO	SYMBOL	INPUT/UNITS	UASB	UAM	State	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	
3		WIND ROAD ANGLE (deg)	20°	10°	84°	
4	x	LATERAL DISTANCE (m)	76	45	91	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	95	173	72	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	47	122	62	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.046	.028	.008	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.010	.012	.003	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	λ/Q^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	195	320	90	
	Qf	ENTER LINE 9	x .010	x .012	x .003	x
11	λ	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	2.0	3.8	0.3	
	U	ENTER LINE 2	3	3	3	
12	λ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.6	1.3	0.1	
13	λ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	—	100	100	
	Qe	ENTER LINE 8	.073	.028	.008	
14	λ	NORMALIZED CONCENTRATION (FOR Yd)	—	2.8	0.8	
	U	ENTER LINE 2	3	3	3	
15	λ	CO CONCENTRATION—"MAXIMUM QUEUE"	—	0.9	0.3	
16	λ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	—	—	90	
	Qe	ENTER LINE 8	x .073	x .028	x .008	x
17	λ	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	—	0.7	
	U	ENTER LINE 2	3	3	3	
18	λ	CO CONCENTRATION—"IMAGINARY QUEUE"	—	—	0.2	
19	λ	CO ($mg\ m^{-3}$) TOTAL	0.6	2.2	0.6	
20	λ	CO CONCENTRATION (ppm) TOTAL	0.6	1.9	0.5	3.0
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		CORRECTION FACTOR				
23		CO CONCENTRATION AT THE [illegible]				
24	λ	CO CONCENTRATION AT THE [illegible]				

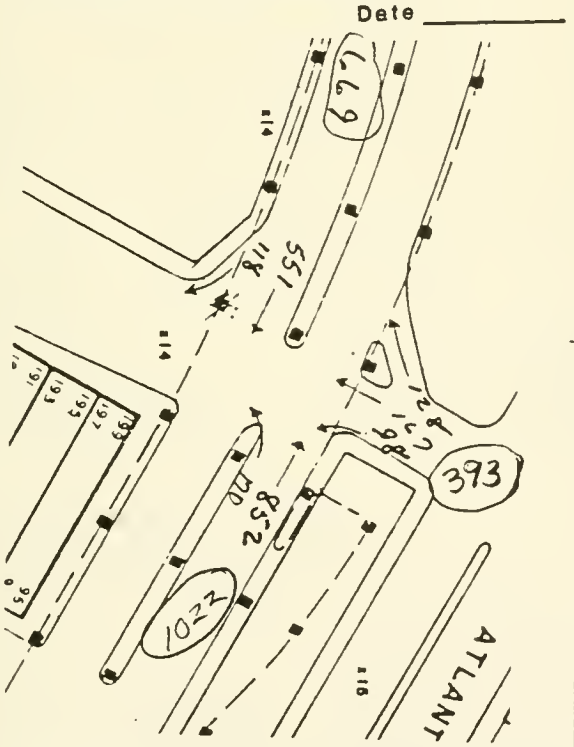
INDICATE

Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

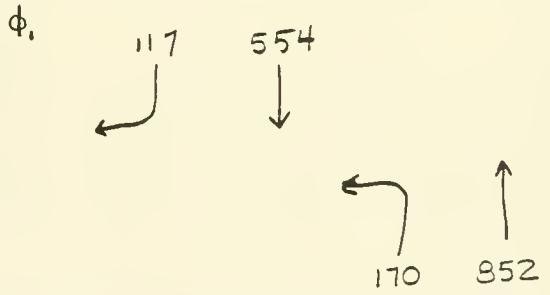
EXISTING/PROPOSED

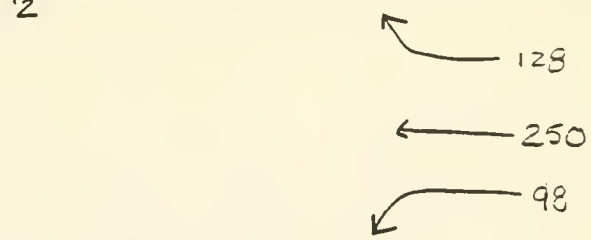


TRAFFIC VOLUMES



SIGNAL PHASING DIAGRAM





Project Title
GEOMETRIC SKETCH PLAN

Drawing Title
1987 1-HOUR NO BUILD
INTERSECTION 2

Project Number

Drawing Number

Drawn By

Scale

Date

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS
WORK SHEET 1987 1-HOUR

PROJECT
INTERSECTION 2

AM/(PM) EXIST/(PROP)

SHEET NO ___ of ___
FILE NO.
DATE
COMP. BY
CHECKED BY

GENERAL DESCRIPTION

NO BUILD

STREET NAME & DIRECTION	UA SB	UA NB	State W		
MOVEMENTS	R-S	L-S	R-S-L		
PHASE	50'	1	2		

PHYSICAL CONDITIONS

PARKING WITHIN 250'	NO · (1) · 2	NO · (1) · 2	(NO) · 1 · 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY	1	1	1		
APPROACH or LANE WIDTH	36'	36'	40'		

STANDARD APPROACHES

LOCATION: (CBD)-F-OBD-R											
AREA FACTOR	fa	6.6	1.00	6.6	1.00	6.5	1.00				
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07				

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPo)	I7										
L or R LOW TYP. (SEP o)	I8-A										
L or R HIGH TYP. (SEP o)	I8-B										
DBL. L or R H.T. (SEP o)	I8-D										
"T" or "Y" (INCL. CASE TYPE)	F-I3										
SPECIAL "T" (OPTION LANE)	F-I2	V'=		V'=		V'=		V'=		V'=	
LEFT TURN ADVANCE GREEN	F-I0										
OTHER (SPECIFY)											
FOR I8-D & F-I3 ONLY: TURNING ANGEL	f_Δ										
FOR I8-D & F-I3 ONLY: ENT. WIDTH	fwe										

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95				
% LEFT TURNS	fl	0	1.025	20	.95	25	.99				
% RIGHT TURNS	fr	18	0.99	0	1.025	33	1.00				
NO. BUSSES/HOUR	fb	—	—	—	—	—	—				
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.03		1.00		1.01					

CALCULATIONS

CLEARANCE INTERVAL (SEC.)	Y	4			4			4									
CYCLE LENGTH (SEC.)	C	100			100			100									
DESIGN: RATIO	Y/C	.04			.04			.04									
DESIGN: INT. S.V., DESIGN (SV·Fi)	ISV	2160	2224		2160	2203		3340	3373								
DESIGN: DESIGN HOUR VOLUME	DHV	671			1022			476									
DESIGN: DESIGN G/C = DHV/ISV	DG/C	0.30			0.46			0.14									
LEVEL OF SERVICE DETERMINATION		ΣY/C + ΣDG/C = .67									LOS =						
ANALYSIS OF SERVICE LEVELS		(A)	B	C	C	D	(E)	(A)	B	C							
ANALYSIS: GREEN INTERVAL (SEC)	G	41			41			51									
ANALYSIS: RATIO	G/C	.41			.41			.51									
ANALYSIS: COMPOSITE FACTOR fi·G/C	fc	.42			.41			.52									
ANALYSIS: CHART SERVICE VOLUME	CSV	1920	2010	2160	2160	2420	2550	3140									
ANALYSIS: ACTUAL SERVICE VOLUME	ASV	804			885	992	1045	1637									
ANALYSIS: PEAK HOUR VOLUME	PHV	671			1022			476									

COMMENTS

rgm 7·80

INTERSECTION 2

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following)

1987 1-HOUR NO BUILD

Project No.: 2026.01 Analyst: R. LOWREY

Site: Marketplace Center Date: 6/18/92

CKD RL 8/28/92

Step	Symbol	Input/Units	Traffic Stream					
1	i	Road segment (or approach identification)	UAss	UAnb	StateW			
2	V_i	Demand volume (vph)	671	1022	476			
3	C_i	Free-flow capacity (vph)						
4	S_i	Cruise speed (mph)	25	10	25			
5	Ef_i	Free-flow emissions (g/veh-m)	.039	0.08	.039			
6.1	M_i	Number of lanes in approach i	3	3	3			
6.2	j	Signalized intersections phase identification	1	1	2			
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1920	2550	3140			
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	671	1022	476			
6.5	C_y	Signal cycle length (s)	100					
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	41	41	51			
6.7	C_i	Capacity of approach i (vph)	1071	1071	1965			
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.9	1.0	0.6			
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	17	28	8			
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.7	21	0.3			
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	50	131	19			
9	Rq_i	Average excess running time on approach (s/veh)	32	100	15			
10	Ea_i	Excess emissions from acceleration (g/veh-m)	0.11	0.24	0.11			
11	Ed_i	Excess emissions from deceleration (g/veh-m)	0.04	0.09	0.04			
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.026	.092	.011			
13	Lad_i	Length of acceleration and deceleration (m)	56	9	56			
14	Le_i	Length over which excess emissions apply (m)	50	131	40			
15	Fs_i	Average idling emission rate (g/s)	0.58	3.22	0.13			
16	Qe	Average excess emission rate (g/m-s)	.040	.031	.019			
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.035	.009	.016			
18	Qfc_i	Free-flow emission rate (g/s-m)	.007	.023	.005			
		17a	.040	.031	.019			
		17b	.006	.022	.003			

135°

Intersection 2 Receptor 1

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS (see instructions following)

1987 1-HOUR NO BUILD

PROJECT NO.: 2026.01 ANALYST: R. Langley CHD RL 6/29/88

SITE: Marketplace Center DATE: 6/19/88

LINE NO	SYMBOL	INPUT/UNITS	JAsB	VANB	State W	
		BASIC INPUTS	TRAFFIC STREAM			
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	
3	θ	WIND ROAD ANGLE (deg)	23	37	57	
4	x	LATERAL DISTANCE (m)	81	113	98	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	130	252	151	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	70	122	130	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.035	.009	.016	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.007	.023	.005	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	180	120	95	
	Qf	ENTER LINE 9	x .007	x .023	x .005	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.3	2.8	0.5	
	U	ENTER LINE 2	/ 1	/ 1	/ 1	/
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	1.3	2.8	0.5	
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	—	130	110	
	Qe	ENTER LINE 8	.035	.009	.016	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	1.2	1.8	
	U	ENTER LINE 2	/ 1	/ 1	/ 1	/
15	χ	CO CONCENTRATION - "MAXIMUM QUEUE"	—	1.2	1.8	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	—	50	110	
	Qe	ENTER LINE 8	x .035	x .009	x .016	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	0.4	1.8	
	U	ENTER LINE 2	/ 1	/ 1	/ 1	/
18	χ	CO CONCENTRATION - "IMAGINARY QUEUE"	—	0.4	1.8	
19	χ	CO ($mg\ m^{-3}$) TOTAL	1.3	4.4	4.0	
20	χ	CO CONCENTRATION (ppm) - TOTAL	1.1	3.8	3.5	8.4
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

180°

Intersection 2 Receptor 2 1987 1-Hour No Build

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

CKD R... 6/23/92

PROJECT NO. 2026.01 ANALYST R...ley

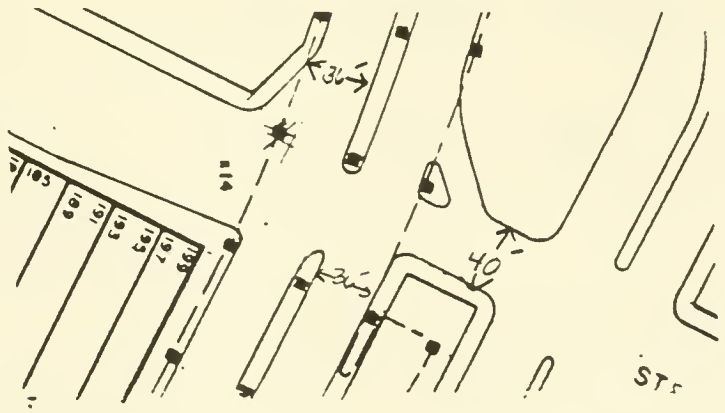
SITE Marketplace Center DATE 6/18/92

LINE NO	SYMBOL	INPUT UNITS	TRAFFIC STREAM UA SB	UA NB	Stve	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	
3		WIND ROAD ANGLE (deg)	20	10	84	
4	x	LATERAL DISTANCE (m)	76	45	91	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	94	252	72	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	38	122	47	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.035	.009	.016	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.007	.023	.005	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	λ/Q^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	195	320	90	
	Q	ENTER LINE 9	x .007	x .023	x .005	x
11	λ	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.4	7.4	0.4	
	U	ENTER LINE 2	1	1	1	
12	λ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	1.4	7.4	0.4	
13	λ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	—	125	100	
	Qe	ENTER LINE 8	.035	.009	.016	
14	λ	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	1.1	1.6	
	U	ENTER LINE 2	1	1	1	
15	λ	CO CONCENTRATION--"MAXIMUM QUEUE"	—	1.1	1.6	
16	λ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	—	—	70	
	Qe	ENTER LINE 8	x .035	x .009	x .016	x
17	λ	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	—	1.1	
	U	ENTER LINE 2	1	1	1	
18	λ	CO CONCENTRATION "IMAGINARY QUEUE"	—	—	1.1	
19	λ	CO ($mg\ m^{-3}$) TOTAL	1.4	8.5	3.1	
20	λ	CO CONCENTRATION (ppm) TOTAL	1.2	7.4	2.7	11.3
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	λ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	λ'	CO CONCENTRATION AT HEIGHT z (ppm)				

INDICATE

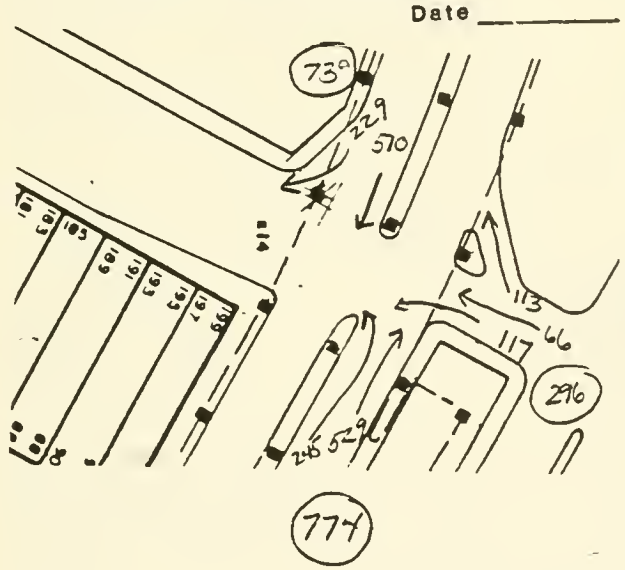
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED

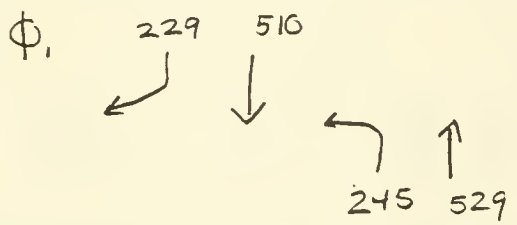


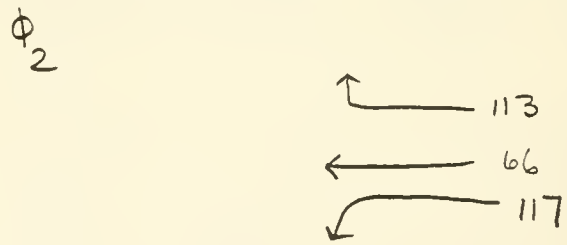
TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM





Project Title	Project Number	Drawn By
GEOMETRIC SKETCH PLAN		RL
Drawing Title	**Drawing Number**	**Scale**
INTERSECTION 2 1987 8-HOUR NO BULD		7/6/82 Date

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92 2471

CAPACITY ANALYSIS
WORK SHEET 1997 2-HOUR NO BUILD

PROJECT
INTERSECTION 2

AM/(PM) EXIST/(PROP)

SHEET NO. ___ of ___
FILE NO.
DATE
COMP. BY
CHECKED BY

GENERAL DESCRIPTION

STREET NAME & DIRECTION		UA SB	UA NB	State		
MOVEMENTS		R-S	L-S	R-S-L		
PHASE		1	1	2		

PHYSICAL CONDITIONS

PARKING WITHIN 250'		NO · (1) · 2	NO · (1) · 2	(NO) · 1 · 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY		1	1	1		
APPROACH or LANE WIDTH		36'	36'	40'		

STANDARD APPROACHES

LOCATION: (CBD)-F-OBD-R											
AREA FACTOR	fa	6.6	1.00	6.6	1.00	6.5	1.00				
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07				

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPe)	I7					
L or R LOW TYP. (SEP o)	I8-A					
L or R HIGH TYP. (SEP o)	I8-B					
DBL. L or R H.T. (SEP o)	I8-D					
"T" or "Y" (INCL. CASE TYPE)	F-13					
SPECIAL "T" (OPTION LANE)	F-12	V'=	V'=	V'=	V'=	V'=
LEFT TURN ADVANCE GREEN	F-10					
OTHER (SPECIFY)						
FOR I8-D & F-13 ONLY: TURNING ANGEL	f_Δ					
FOR I8-D & F-13 ONLY: ENT. WIDTH	fwe					

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95				
% LEFT TURNS	fl	0	1.05	32	.90	40	1.00				
% RIGHT TURNS	fr	31	1.00	0	1.025	38	1.00				
NO. BUSSES / HOUR	fb	—	—	—	—	—	—				
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.07		.94		1.02					

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4										
CYCLE LENGTH (SEC.)		C	77			77			77										
DESIGN	RATIO	Y/C	.05			.05			.05										
DESIGN	INT. S.V., DESIGN (SV·Fi)	ISV	2160	2311		2160	2030		3340	3407									
DESIGN	DESIGN HOUR VOLUME	DHV	739			774			296										
DESIGN	DESIGN G/C = DHV / ISV	DG/C	.32			.38			.09										
LEVEL OF SERVICE DETERMINATION			ΣY/C + ΣDG/C =									LOS =							
ANALYSIS OF SERVICE LEVELS			(A)	B	C	A	B	(C)	(A)	B	C								
ANALYSIS	GREEN INTERVAL (SEC)	G	28			28			41										
ANALYSIS	RATIO	G/C	.36			.36			.53										
ANALYSIS	COMPOSITE FACTOR fi·G/C	fc	.39			.34			.54										
ANALYSIS	CHART SERVICE VOLUME	CSV	2010	2160		2010	2160	2420	3140										
ANALYSIS	ACTUAL SERVICE VOLUME	ASV	783			683	734	822	1695										
ANALYSIS	PEAK HOUR VOLUME	PHV	739			774			296										

COMMENTS

INTERSECTION 2

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following)

1987 8-HOUR NO BUILD

Project No.: EC86.01 Analyst: RL

Site: Marketplace Center Date: 7/7/87

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UASE	UANB	StateW	
2	V_i	Demand volume (vph)	739	774	296	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	15	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.026	.040	.026	
6.1	M_i	Number of lanes in approach i	3	3	3	
6.2	J	Signalized intersections phase identification	1	1	2	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2010	2420	3140	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	739	774	296	
6.5	C_y	Signal cycle length (s)	77			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	25	28	41	
6.7	C_i	Capacity of approach i (vph)	867	867	2041	
6.8	$P_{i,j}$	Proportion of vehicles that stop	1.0	0.9	0.5	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	16	15	3	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	5.8	8	0.2	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	58	61	8	
9	Rq_i	Average excess running time on approach (s/veh)	42	55	9	
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.11	.16	.11	
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.04	.06	.04	
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.031	.043	.006	
13	Lad_i	Length of acceleration and deceleration (m)	56	20	56	
14	Le_i	Length over which excess emissions apply (m)	58	61	40	
15	Fs_i	Average idling emission rate (g/s)	.89	1.3	.038	
16	Qe	Average excess emission rate (g/m-s)	.045	.035	.005	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.040	.027	.004	
18	Qfc_i	Free-flow emission rate (g/s-m)	.005	.009	.002	

17a .045 .035 .005

17b .005 .008 .001

135°

INTERSECTION 2 RECEPTOR 1

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS 1997 2-HOUR NO BUILD

(see instructions following)

PROJECT NO.: 2026.01 ANALYST: RL

SITE Marketplace Center DATE: 7/7/82

LINE NO	SYMBOL	INPUT/UNITS	UAse	UAne	Stse	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	
3	ϕ	WIND ROAD ANGLE (deg)	23°	37°	57°	
4	x	LATERAL DISTANCE (m)	81	113	98	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	120	183	138	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	62	122	130	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.040	.027	.004	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.005	.009	.002	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	180	120	95	
	Qf	ENTER LINE 9	x .005	x .009	x .002	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{1}$)	0.9	1.1	0.2	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	÷
12	χ	CO CONCENTRATION ($mg\ m^{3}$) THROUGH EMISSIONS	0.3	0.4	.06	
13	$\chi U Q^{1}$	NORMALIZED CONCENTRATION (FOR Yu)	—	135	110	
	Qe	ENTER LINE 8	.040	.027	.004	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{1}$)	—	3.6	0.4	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	—	1.2	0.2	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	—	50	110	
	Qe	ENTER LINE 8	x .040	x .027	x .004	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{1}$)	—	1.4	0.4	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	÷
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	—	0.4	0.2	
19	χ	CO ($mg\ m^{3}$) TOTAL	0.3	2.0	0.4	
20	χ	CO CONCENTRATION (ppm) TOTAL	0.3	1.7	0.3	2.3
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

180°

INTERSECTION 2 RECEPTOR 2

WORKSHEET 5: INTERSECTION CO DISPERSION ANALYSIS (see instructions following)

1992 8-HOUR NO BUILD

PROJECT NO.: 2026.01 ANALYST RL

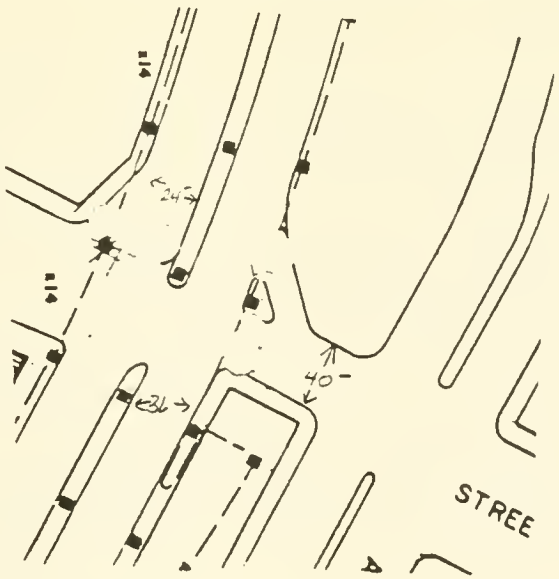
SITE: Marketplace Center DATE: 7/7/92

LINE NO	SYMBOL	INPUT/UNITS	UASB	UANB	State	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	
3	ϕ	WIND ROAD ANGLE (deg)	20	10	84	
4	x	LATERAL DISTANCE (m)	76	45	91	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	95	183	72	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	33	122	64	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.048	.027	.004	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.005	.009	.002	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	195	320	90	
	Qf	ENTER LINE 9	x .005	x .009	x .002	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.0	2.9	0.2	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.3	1.0	0.1	
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	—	110	100	
	Qe	ENTER LINE 8	.048	.027	.004	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	3.0	0.4	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	—	1.0	0.1	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	—	—	90	
	Qe	ENTER LINE 8	x .048	x .027	x .004	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	—	0.4	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	—	—	0.1	
19	χ	CO ($mg\ m^{-3}$) TOTAL	0.3	2.0	0.3	
20	χ	CO CONCENTRATION (ppm)--TOTAL	0.3	1.7	0.3	2.3
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

INDICATE

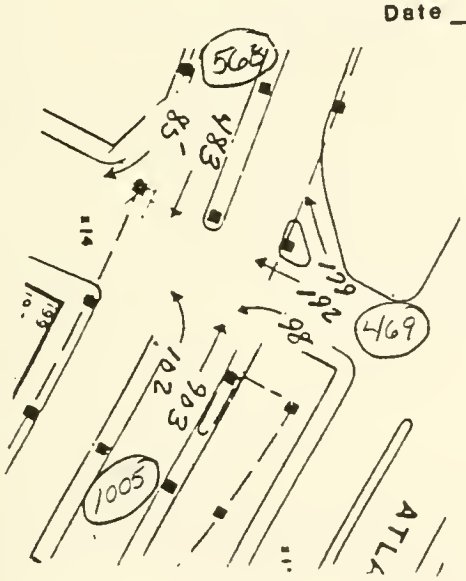
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking restrictions

EXISTING/PROPOSED

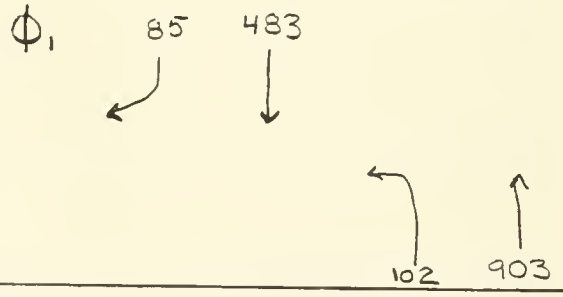


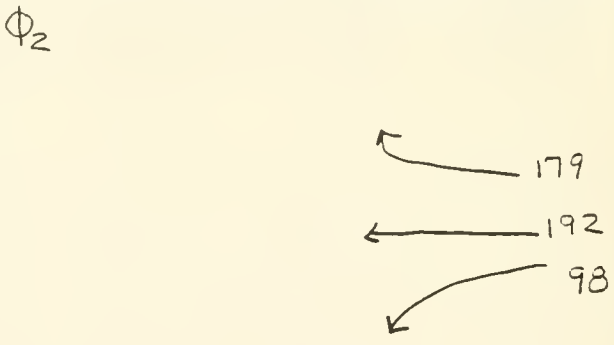
TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM





Project Title	Project Number	Drawn By
GEOMETRIC SKETCH PLAN		RL
Drawing Title	**Drawing Number**	**Scale**
INTERSECTION 2 1987 1-HOUR BUILD		7/1/82 Date

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS WORK SHEET 1987 1-HOUR BUILD

PROJECT _____
INTERSECTION 2
AM/(PM) EXIST/(PROP)

SHEET NO. ___ of ___
FILE NO. _____
DATE _____
COMP. BY _____
CHECKED BY _____

GENERAL DESCRIPTION

STREET NAME & DIRECTION	UA SB	UA NB	State		
MOVEMENTS	R-S	L-S	R-S-L		
PHASE	1	1	2		

PHYSICAL CONDITIONS

PARKING WITHIN 250'	(NO) 1 · 2	NO · (1) 2	(NO) · 1 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY	1	1	1		
APPROACH or LANE WIDTH	24'	36'	40'		

STANDARD APPROACHES

LOCATION: (CBD) F-OBD-R											
AREA FACTOR	fa	6.5	1.00	6.6	1.00	6.5	1.00				
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.85	1.07				

SPECIAL APPROACHES

L or R TURN LANE (NO. SEPe)	I7								
L or R LOW TYP. (SEP o)	I8-A								
L or R HIGH TYP. (SEP o)	I8-B								
DBL. L or R H.T. (SEP o)	I8-D								
"T" or "Y" (INCL. CASE TYPE)	F-13								
SPECIAL "T" (OPTION LANE)	F-12	V'=		V'=		V'=		V'=	V'=
LEFT TURN ADVANCE GREEN	F-10								
OTHER (SPECIFY)									
FOR I8-D & F-13 ONLY: TURNING ANGEL	f_Δ								
ENT. WIDTH	fwe								

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95		
% LEFT TURNS	fl	0	1.025	10	1.00	21	0.98		
% RIGHT TURNS	fr	15	0.49	0	1.025	38	1.00		
NO. BUSSES/HOUR	fb	—	—	—	—	—	—		
INTERMEDIATE FACTOR Fi = fo·fpphf·fa·fwe·ft·fl·fr·fb		1.03		1.04		1.00			

CALCULATIONS

CLEARANCE INTERVAL (SEC.)		Y	4			4			4											
CYCLE LENGTH (SEC.)		C	100			100			100											
DESIGN	RATIO	Y/C	.04			.04			.04											
	INT. S.V., DESIGN (SV·Fi)	ISV	1950	2008		2160	2246		3340	3340										
	DESIGN HOUR VOLUME	DHV	568			1005			467											
	DESIGN G/C = DHV/ISV	DG/C	.28			.45			.14											
LEVEL OF SERVICE DETERMINATION			ΣY/C + ΣDG/C =									LOS =								
ANALYSIS OF SERVICE LEVELS			(A)	B	C	C	(D)	E	(A)	B	C									
ANALYSIS	GREEN INTERVAL (SEC)	G	41			41			51											
	RATIO	G/C	.41			.41			.51											
	COMPOSITE FACTOR fi·G/C	fc	.42			.43			.51											
	CHART SERVICE VOLUME	CSV	1850	1890	1950	2160	2420	2598	3300											
	ACTUAL SERVICE VOLUME	ASV	777			929	1041	1096	1683											
	PEAK HOUR VOLUME	PHV	568			1005	1005		467											

COMMENTS

rgm 7·80

INTERSECTION 2

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following)

1997 1-HOUR BUILD

Project No.: 2636.01 Analyst: RL

Site: Marketplace Center Date: 7/11/97

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UASB	UANB	State	
2	V_i	Demand volume (vph)	568	1005	469	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	10	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.039	.076	.039	
6.1	N_i	Number of lanes in approach i	2	3	3	
6.2	j	Signalized intersections phase identification	1	1	2	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1850	2420	3300	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	568	1005	469	
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	41	41	51	
6.7	C_i	Capacity of approach i (vph)	932	1096	1928	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.6	1	0.6	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	10	28	8	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.6	11		0.3
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	46	104		22
9	Rq_i	Average excess running time on approach (s/veh)	24	65		15
10	Ea_i	Excess emissions from acceleration (g/veh-m)	.11	.24		.11
11	Ed_i	Excess emissions from deceleration (g/veh-m)	.04	.09		.04
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)	.015	.092		.012
13	Lad_i	Length of acceleration and deceleration (m)	56	9		56
14	Le_i	Length over which excess emissions apply (m)	46	104		40
15	Fs_i	Average idling emission rate (g/s)	.35	2.04		0.15
16	Qe	Average excess emission rate (g/m-s)	.026	.028		.021
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.022	.007		.018
18	Qfc_i	Free-flow emission rate (g/s-m)	.006	.021		.005

17a .026 .028 .021

17b .004 .021 .003

180°

INTERSECTION 2 RECEPTOR 2

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS 1987 1-HOUR BUILD
(see instructions following)

PROJECT NO.: 2026.01 ANALYST: RL

SITE: Marketplace Center DATE: 7/1/82

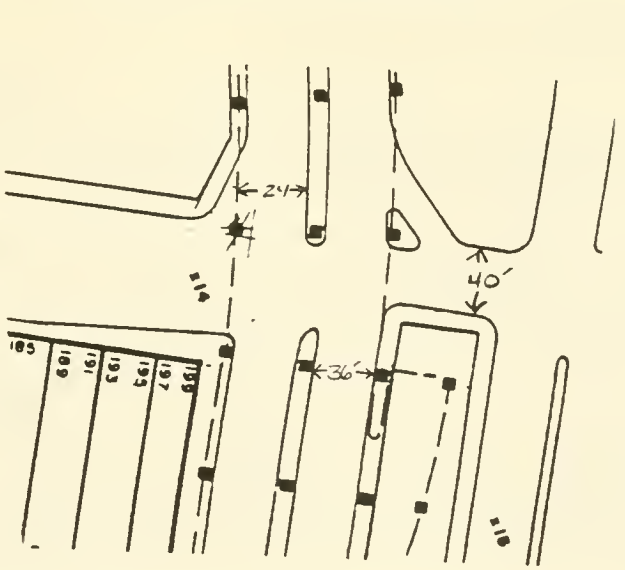
LINE NO	SYMBOL	INPUT/UNITS	UA_{SB}	UA_{NB}	State	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1	1	1	
3	ψ	WIND ROAD ANGLE (deg)	20	10	34	
4	x	LATERAL DISTANCE (m)	76	45	91	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	94	222	72	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	44 ~~63~~	122	49	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.022	.007	.018	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006	.021	.005	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	χ/Q^{-1}	NORMALIZED CONCENTRATION ($10^{3}\ m^{-1}$) FREE FLOW	195	320	90	
	Qf	ENTER LINE 9	x .006	x .021	x .005	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.2	6.7	0.4	
	U	ENTER LINE 2	/ 1	/ 1	/ 1	/
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	1.2	6.7	0.4	
13	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	—	100	100	
	Qe	ENTER LINE 8	.022	.007	.018	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	0.7	1.8	
	U	ENTER LINE 2	/ 1	/ 1	/ 1	/
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	—	0.7	1.8	
16	χ/Q^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	—	15	100	
	Qe	ENTER LINE 8	x .022	x .007	x .018	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	0.10	1.8	
	U	ENTER LINE 2	/ 1	/ 1	/ 1	/
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	—	0.10	1.8	
19	χ	CO ($mg\ m^{-3}$) TOTAL	1.2	7.5	4.0	
20	χ	CO CONCENTRATION (ppm)--TOTAL	1.0	6.5	3.5	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

11.0

INDICATE

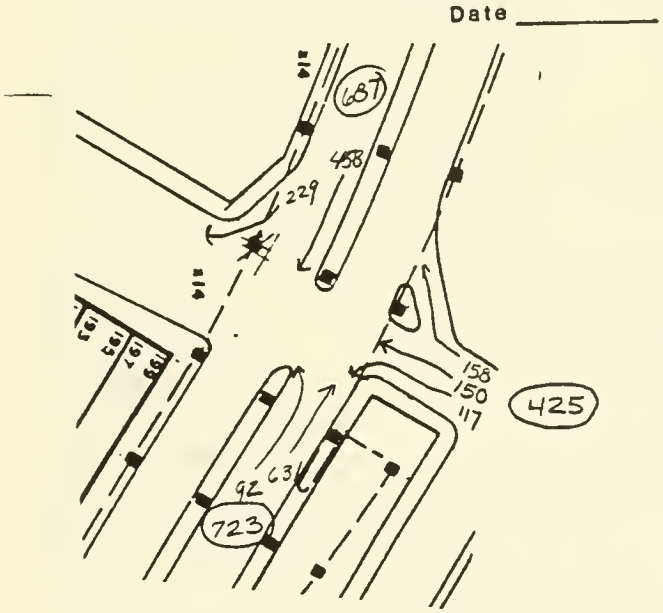
Right of way
Pavement widths
Sidewalks
Channelization
Signal
Medians
Left storage lane
Parking reatrictions

EXISTING/PROPOSED

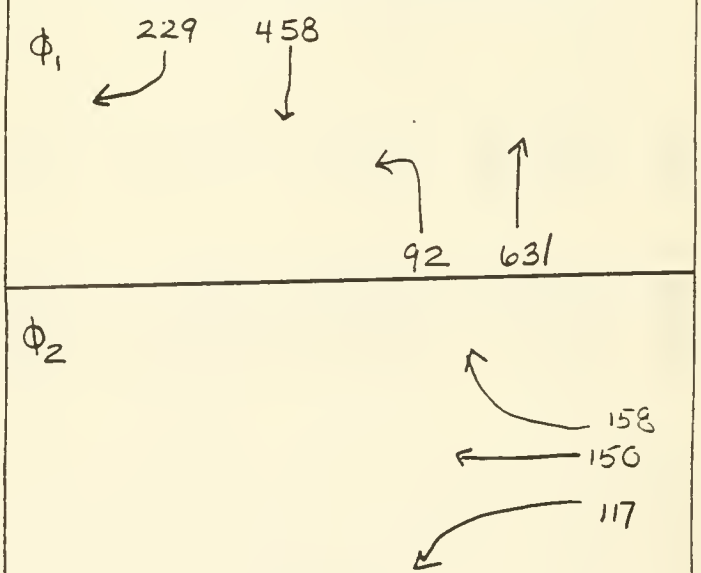


TRAFFIC VOLUMES

Date _____



SIGNAL PHASING DIAGRAM



Project Title
GEOMETRIC SKETCH PLAN

Project Number

Drawn By
RL

Drawing Title
INTERSECTION 2 1987 8-HOUR BUILD

Drawing Number

Scale

Date
7/12/82

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471

CAPACITY ANALYSIS BUILD
WORK SHEET 1987 8-HOUR

PROJECT
INTERSECTION 2
AM/PM EXIST / (PROP)

SHEET NO. ___ of ___
FILE NO.
DATE
COMP. BY
CHECKED BY

GENERAL DESCRIPTION

STREET NAME & DIRECTION	UA SB	UA NB	State		
MOVEMENTS	R-S	L-S	R-S-L		
PHASE	1	1	2		

PHYSICAL CONDITIONS

PARKING WITHIN 250'	(NO) · 1 · 2	NO (1) 2	(NO) · 1 · 2	NO · 1 · 2	NO · 1 · 2
ONE WAY or TWO WAY	1	1	1		
APPROACH or LANE WIDTH	24'	36'	40'		

STANDARD APPROACHES

LOCATION: CBD-F-OBD-R											
AREA FACTOR	fa	6.5	1.00	6.6	1.00	6.5	1.00				
POP x 1,000 = ( ), PHF	fpphf	.85	1.07	.85	1.07	.95	1.07				

SPECIAL APPROACHES

L or R TURN LANE (NO. SEP o)	I7										
L or R LOW TYP. (SEP o)	I8-A										
L or R HIGH TYP. (SEP o)	I8-B										
DBL. L or R H.T. (SEP o)	I8-D										
"T" or "Y" (INCL. CASE TYPE)	F-I3										
SPECIAL "T" (OPTION LANE)	F-I2	V'=		V'=		V'=		V'=		V'=	
LEFT TURN ADVANCE GREEN	F-I0										
OTHER (SPECIFY)											
FOR I8-D & F-I3 ONLY: TURNING ANGEL	f_Δ										
ENT. WIDTH	fwe										

TRAFFIC CHARACTERISTICS

% TRUCKS	ft	10	.95	10	.95	10	.95				
% LEFT TURNS	fl	0	1.10	13	.97	28	.93				
% RIGHT TURNS	fr	33	0.90	0	1.10	37	1.00				
NO. BUSSES / HOUR	fb	—	—	—	—	—	—				
INTERMEDIATE FACTOR Fi = fa·fpphf·fΔ·fwe·ft·fl·fr·fb		1.01		1.08		1.01					

CALCULATIONS

CLEARANCE INTERVAL (SEC.)	Y	4			4			4													
CYCLE LENGTH (SEC.)	C	77			77			77													
DESIGN: RATIO	Y/C	.05			.05			.05													
DESIGN: INT. S.V., DESIGN (SV·Fi)	ISV	1950	1970		2160	2333		3340	3373												
DESIGN: DESIGN HOUR VOLUME	DHV	687			723			425													
DESIGN: DESIGN G/C = DHV / ISV	DG/C	.35			.31			.13													
LEVEL OF SERVICE DETERMINATION		Σ Y/C + Σ DG/C =									LOS =										
ANALYSIS OF SERVICE LEVELS		A	(B)	C	(A)	B	C	(A)	B	C											
ANALYSIS: GREEN INTERVAL (SEC)	G	28			28			41													
ANALYSIS: RATIO	G/C	.36			.36			.53													
ANALYSIS: COMPOSITE FACTOR fi·G/C	fc	.37			.39			.54													
ANALYSIS: CHART SERVICE VOLUME	CSV	1850	1890	1950	2160	2420	2550	3300													
ANALYSIS: ACTUAL SERVICE VOLUME	ASV	684	699		842			1782													
ANALYSIS: PEAK HOUR VOLUME	PHV	687			723			425													

COMMENTS

180°

INTERSECTION 2 RECEPTOR 2

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS (see instructions following)

1987 3-HOUR BUILD

PROJECT NO. 2026.01 ANALYST: RL

SITE Marketplace Center DATE: 7/12/82

LINE NO	SYMBOL	INPUT/UNITS	UASB	UANB	State	
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	3	3	3	
3	θ	WIND ROAD ANGLE (deg)	20	10	64	
4	x	LATERAL DISTANCE (m)	76	45	91	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	94	170	72	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	—	122	60	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.022	.043	.010	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006	.005	.003	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	195	320	90	
	Qf	ENTER LINE 9	x .006	x .005	x .003	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.2	1.6	0.3	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	÷
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.4	0.5	0.1	
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	—	50	100	
	Qe	ENTER LINE 8	.022	.043	.010	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	—	2.2	1.0	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	—	0.7	0.3	
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	—	15	100	
	Qe	ENTER LINE 8	x .022	x .043	x .010	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	—	0.6	1.0	
	U	ENTER LINE 2	÷ 3	÷ 3	÷ 3	÷
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	—	0.2	0.3	
19	χ	CO ($mg\ m^{-3}$) TOTAL	0.4	1.4	0.7	
20	χ	CO CONCENTRATION (ppm)--TOTAL	0.3	1.2	0.6	2.2
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

APPENDIX E

STREET CANYON ANALYSIS

PROJECT NO 2026.01 SASAKI ASSOCIATES, INC. SHEET NO. ____ OF ____
TITLE Marketplace Center 64 PLEASANT STREET WATERTOWN, MA 02172 DATE 7/2/82
BY RL CK'D

Determination of Street Canyon Underneath the Central Artery for 1987 BUILD (1-HOUR)

$\delta = 7(KW/U)^{1/2}$

where 7 = empirical factor
K = turbulent diffusivity of momentum ~ $1\ m^2/sec^5$
W = street canyon width, m
U = rooftop wind speed, m/sec

$\sigma = 7\left[(1)(27)/1\right]^{1/2}$

$\delta = 7(27)^{1/2}$ $\delta = 7(5.2) = 36$

see sheet C-5

Leeward Component angles 120° - 15°

$$\Delta x_L = \frac{K\,Q'_s\,(10^3)}{(u+0.5)\,(x^2+z^2)^{1/2}} + L_0$$

where

$K \sim 7$, an empirical nondimensional constant

$L_0 \sim 2$m, approximate vehicle length

x (m), horizontal distance from stream center to receptor

z (m), vertical distance from ground level

u (m/sec), rooftop wind speed, estimate from nearby airport wind speed if local data not available

Q'_s (g/msec), average CO emission rate in the street

x (mg/m^3), CO concentration

Under Artery N.B.

$$\Delta x_L = \frac{7\,(.011)\,(10^3)}{(1+0.5)\,(64^2+1.5^2)^{1/2}+2} = \frac{77}{(1.05)(64)+2}$$

$$= \frac{77}{69} = 1.12$$

1987 1-HOUR BUILD

Instructions for Street Canyon*

C-1 Enter Hb (average building height, m) (height of Central Artery) 6.1

Enter W (average street canyon width, m) 27.0

C-2 Enter U (rooftop wind speed, estimated or measured, m/sec) 1

C-3 Enter roadway/wind angle (θ) this includes wind angles of 120°, 105°, 90°, 75°, 60°, 45°, 30°, 15° and 0° 45 — 75°

C-4 Calculate δ using equation C-1(m) 36

C-5 Circle one:

θ ≥ 30° and δ < Hb	Street canyon effects possible, continue with Step C-6
θ < 30° and δ < Hb	Vortex not obvious, return to original worksheet
θ ≥ 30° and δ ≥ Hb	(No street canyon effect)
θ < 30° and δ ≥ Hb	go back to original worksheet

C-6 Determine if receptor is on windward or leeward side of street (See Figure C-1). Circle one:

windward (leeward)

C-7 Use the proper equation (leeward, C-3, windward, C-4) to determine the CO concentration. Receptor distances x and z are the same as originally set up by the user. Q_s' is calculated on Worksheet 2.

For free flow $Q_s' = Q_f$ (Worksheet 2, line 18) = .011 (g/sec m) UA NB

$Q_{1,s}' = Q_f$ (

For intersections $Q_s' = Q_f + Q_e$ = ——— (g/sec m) UA SB

where Q_f = Worksheet 2, line 18 for link under consideration plus for link opposite that under consideration

Q_e = Worksheet 2, line 17 for link under consideration

x = 1.12 (mg/m³)

*At an intersection the instructions apply to only the link where the receptor is located.

* still assume street canyon possible due to configuration of BUILD Alternative

SASAKI ASSOCIATES, INC.
64 PLEASANT STREET
WATERTOWN, MA 02172

Under Artery S.E.

$$\Delta x_L = \frac{7(.006)(10^3)}{(1.5)(79^2 + 15^2)^{1/2} + 2} = \frac{42}{(1.5)(79) + 2}$$

$$\frac{42}{120} = .35$$

Windward angles

The windward-side component (Δx_W) is calculated by

$$\Delta x_W = \frac{K\,O'_s\,(Hb-z)(10^3)}{W(u+0.5)Hb}$$

where

W(m), street canyon width

Hb(m), average building height

$$UA_{SB} = \Delta x_W = \frac{(7)(.011)(6.1-1.5)(1000)}{27(1.5)(6.1)} \qquad \begin{array}{r} 354 \\ -47 \end{array} = 1.4$$

1987 1-HOUR BUILD

Instructions for Street Canyon*

C-1 Enter Hb (average building height, m) 6.1

Enter W (average street canyon width, m) 27.0

C-2 Enter U (rooftop wind speed, estimated or measured, m/sec) 1

C-3 Enter roadway/wind angle (θ) angles 180°, 195°, 210°; 225°, 240° 30, 45, 60, 75, 90

C-4 Calculate δ using equation C-1(m) 36

C-5 Circle one:

θ ≥ 30° and δ < Hb — Street canyon effects possible, continue with Step C-6

θ < 30° and δ < Hb — Vortex not obvious, return to original worksheet

θ ≥ 30° and δ ≥ Hb — (No street canyon effect)

θ < 30° and δ ≥ Hb — go back to original worksheet

C-6 Determine if receptor is on windward or leeward side of street (See Figure C-1). Circle one:

(windward) leeward

C-7 Use the proper equation (leeward, C-3, windward, C-4) to determine the CO concentration. Receptor distances x and z are the same as originally set up by the user. Q'_s is calculated on Worksheet 2.

For free flow $Q'_s = Q_f$ (Worksheet 2, line 18) = _____ (g/sec m)

For intersections $Q'_s = Q_f + Q_e$ = _____ (g/sec m)

where Q_f = Worksheet 2, line 18 for link under consideration plus for link opposite that under consideration

Q_e = Worksheet 2, line 17 for link under consideration

x = _____ (mg/m^3)

*At an intersection the instructions apply to only the link where the receptor is located.

* still assume street canyon possible due to configuration of Build Alternative

PROJECT NO 2026.01
TITLE Marketplace Center

SASAKI ASSOCIATES, INC.
64 PLEASANT STREET
WATERTOWN, MA 02172

SHEET NO. ____ OF ____
DATE 6/17/82
BY RL CK'D ____

1-Hour 1982 Existing Conditions

	Marketplace	Waterfront Park
Intersection 1	23.1 (0°)	23.6 (270°)
Intersection 2	13.5 (135°)	14.2 (180°)
Under Artery South bound	2.0 (150°)	2.1 (300°)
Under Artery North bound	—	3.5 (300°)
Commercial St. Northbound	4.9 (0°)	—
State St. West bound	1.1 (90°)	1.2 (240°)

APPENDIX F

FREE FLOW TRAFFIC ANALYSIS

1982 1-Hour No Build

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 2026.01 Analyst: Ramsey

Site: Marketplace Center Date: 6/16/82

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UA SB	UA NB	Conn N	State
2	V_i	Demand volume (vph)	655	956	277	526
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	15	25
5	Ef_i	Free-flow emissions (g/veh-m)	.059	.059	.089	.059
6.1	M_i	Number of lanes in approach i				
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)				
6.4	$V_{i,j}$	Demand volume for approach i, phase j (veh)				
6.5	C_y	Signal cycle length (s)				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)				
6.7	C_i	Capacity of approach i (vph)				
6.8	$P_{i,j}$	Proportion of vehicles that stop				
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle				
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase				
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)				
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	Excess emissions from acceleration (g/veh-m)				
11	Ed_i	Excess emissions from deceleration (g/veh-m)				
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average excess emission rate (g/m-s)				
17	Qe'_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)	.011	.016	.007	.009

ADD w/ INT Z

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst R. Longley

Site: Marketplace Center Date: 6/16/82

1982 1-HOUR NO BUILD

Receptor 1

Step	Symbol	Input/Units	90°			105°			120°		
		Basic inputs	UAsb	State	Comm	UAsb	State	Comm	UAsb	State	Com
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	77	10	85	62	25	70	47	40	55
4		Sin θ	.97	.17	1.00	.88	.42	.94	.73	.64	.82
5	x	Road receptor distance (m)	73	106	9	73	106	9	73	106	9
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.011	.009	.007	.011	.009	.007	.011	.009	.007
7a		Street canyon? (yes or no)	no			no	—			NO	
		Dispersion computation									
8	xU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	100	180	150	105	150	160	120	105	170
9	xU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.1	1.6	1.1	1.2	1.4	1.1	1.3	1.0	1.2
10	x	CO concentration ($mg\ m^{-3}$)	1.1	1.6	1.1	1.2	1.4	1.1	1.3	1.0	1.2
11	x	CO concentration (ppm)	1.0	1.4	0.9	1.0	1.2	0.9	1.1	0.8	1.0
					3.3		3.1			2.9	
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)				—	—	—	—		
13		z-correction factor				—	—	—	—		
14	x'	CO concentration at height z (mg/m^3)				—	—	—	—		
15	x	CO concentration at height z (ppm)				—	—	—	—		

ADD WY TIT 2

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst: R. Longley

Site: Marketplace Center Date: 6/16/82

1982 1-HOUR NO BUILD

Receptor 1

Step	Symbol	Input/Units	135°			150°			165°			
		Basic inputs	UAsa	State	Comm	UAsa	State	Comm	UAsa	State	Comm	
1	SC	Stability class	D	D	D	D	D	D	D	D	D	
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1	
3	θ	Wind/road angle (deg)	32	55	40	17	70	25	2	85	10	
4		Sin θ	.53	.82	.64	.30	.94	.42	.03	1.00	.17	
5	x	Road receptor distance (m)	73	106	9	73	106	9	73	106	9	
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	
7	Q_o	Emission rate ($g\ m^{-1}\ s^{-1}$)	.011	.009	.007	.011	.009	.007	.011	.009	.007	
7a		Street canyon? (yes or no)		NO			No			NO		
		Dispersion computation										
8	xU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	160	75	210	205	80	310	190	80	630	
9	xU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.8	0.9	1.5	2.3	0.7	2.2	2.1	0.7	4.4	
10	x	CO concentration ($mg\ m^{-3}$)	1.8	0.9	1.5	2.3	0.7	2.2	2.1	0.7	4.4	
11	x	CO concentration (ppm)	1.5	0.7	1.3	2.0	0.6	1.9	1.8	0.6	3.8	
				3.5			1.5				6.2	
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor										
14	x'	CO concentration at height z (mg/m^3)										
15	x'	CO concentration at height z (ppm)										

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) ADD ON UNIT 2

Project No.: 2026.01 Analyst R. Langley

Site: Marketplace Center Date: 6/17/82

Receptor 2

1982 1-HOUR 1st BUILD

Step	Symbol	Input/Units	165°			180°			195°		
		Basic inputs	UAsb	UAnb	State	UAsb	UAnb	State	UAsb	UAnb	State
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed (m s^{-1})	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	15	15	90	30	30	75	45	45	60
4		Sin θ	.26	.26	1.00	.50	.50	.97	.71	.71	.87
5	x	Road receptor distance (m)	82	67	91	82	67	91	82	67	91
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate (g m^{-1} s^{-1})	.011	.016	.009	.011	.016	.009	.011	.016	.009
7a		Street canyon? (yes or no)		NO			NO			NO	
		Dispersion computation									
8	xU/Q	Normalized concentration (10^{-3} m^{-1})	200	245	90	160	175	90	130	145	100
9	xU	Normalized concentration (mg m^{-2} s^{-1})	2.2	3.9	0.8	1.8	2.8	0.8	1.4	2.3	0.9
10	x	CO concentration (mg m^{-3})	2.2	3.9	0.8	1.8	2.8	0.8	1.4	2.3	0.9
11	x	CO concentration (ppm)	1.9	3.4	0.7	1.5	2.4	0.7	1.2	2.0	0.9
				6.0			4.6			4.1	
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)									
13		z-correction factor									
14	x'	CO concentration at height z (mg/m^3)									
15	x'	CO concentration at height z (ppm)									

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (See instructions following)

Project No.: 2026.01 Analyst: R. Longley ADD W/ INT 2

Site: Marketplace Center Date: 6/17/82 1982 1-HOUR NO BUILD

Receptor 2

Step	Symbol	Input/Units	210°			225°			240°			
		Basic inputs	UAsb	UAnb	State	UAsb	UAnb	State	UAsb	UAnb	State	
1	SC	Stability class	D	D	D	D	D	D	D	D	D	
2	U	Wind speed (m s^{-1})	1	1	1	1	1	1	1	1	1	
3	θ	Wind/road angle (deg)	60	60	45	75	75	30	90	90	15	
4		Sin θ	.87	.87	.71	.97	.97	.50	1.0	1.0	.26	
5	x	Road receptor distance (m)	82	67	91	82	67	91	82	67	91	
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	
7	Q	Emission rate (g m^{-1} s^{-1})	.011	.016	.009	.011	.016	.009	.011	.016	.009	
7a		Street canyon? (yes or no)		NO			NO			NO		
		Dispersion computation										
8	χU/Q	Normalized concentration (10^{-3} m^{-1})	105	120	120	95	110	150	95	105	200	
9	χU	Normalized concentration (mg m^{-2} s^{-1})	1.2	1.9	1.1	1.0	1.8	1.4	1.0	1.7	1.8	
10	χ	CO concentration (mg m^{-3})	1.2	1.9	1.1	1.0	1.8	1.4	1.0	1.7	1.8	
11	χ	CO concentration (ppm)	1.0	1.7	0.9	0.9	1.5	1.2	0.9	1.5	1.6	
				3.6			3.6			4.0		
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor										
14	χ'	CO concentration at height z (mg/m^3)										
15	χ'	CO concentration at height z (ppm)										

ADD W/ INT. 1

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 80-6.01 Analyst R. L 1982 1-HOUR

Site: Marketplace Center Date: 6/15/82 NO BUILD

Receptor 1

Step	Symbol	Input/Units	75°			60°		45° Traffic Stream		30°		15°	
		Basic inputs	N Comm	UA SB	UA NB	N Comm	SS UA	N Comm	SB UA	N Comm		N Com	SB UH
1	SC	Stability class	D	D	D	P	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	80	56	56	65	71	50	86	35	79	20	64
4		Sin θ	.98	.83	.83	.91	.95	.78	1.0	.57	1.0	.35	.90
5	x	Road receptor distance (m)	9	70	85	9	70	9	70	9	70	9	70
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.007	.041	.016	.007	.011	.001	.041	.007	.011	.007	.041
7a		Street canyon? (yes or no)						—					
		Dispersion computation											
8	xU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	150	120	110	170	100	180	105	240	105	350	110
9	xU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.0	1.3	1.8	1.2	1.1	1.3	1.2	1.7	1.2	2.4	1.2
10	x	CO concentration ($mg\ m^{-3}$)	1.0	1.3	1.8	1.2	1.1	1.3	1.2	1.7	1.2	2.4	1.2
11	x	CO concentration (ppm)	.9	1.1	1.5	1.0	1.0	1.1	1.0	1.5	1.0	2.1	1.0
			Σ 3.5			Σ 2.0		Σ = 2.1		2.5		3.1	
		Optional z-correction (heights other than 1.8 m above ground)											
12	z	Height receptor (m)						—	—	—	—		
13		z-correction factor						—	—	—	—		
14	x'	CO concentration at height z (mg/m^3)						—	—	—	—		
15	x'	CO concentration at h...						—	—	—	—		

ADD W/ INT. 1

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst R.L.

Site: Marketplace Center Date: 6/15/87

1982 1-HOUR NO BUILD

Receptor 1

Step	Symbol	Input/Units	Identification	0° Traffic Stream N Comm	SB VA	345 SB UA	
		Basic inputs					
1	SC	Stability class		D	D	D	
2	U	Wind speed ($m\ s^{-1}$)		1	1	1	
3	θ	Wind/road angle (deg)		5	45	30	
4		Sin θ		.09	.05	.5	
5	x	Road receptor distance (m)		9	70	70	
6	σ_{z_o}	Initial dispersion (m)		5	5	5	
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)		.007	.011	.011	
7a		Street canyon? (yes or no)					
		Dispersion computation					
8	xU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)		800	140	180	
9	xU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)		5.6	1.5	2.0	
10	x	CO concentration ($mg\ m^{-3}$)		5.6	1.5	2.0	
11	x	CO concentration (ppm)		4.9	1.3	1.7	
					6.2	1.7	
		Optional z-correction (heights other than 1.8 m above ground)					
12	z	Height receptor (m)					
13		z-correction factor					
14	x'	CO concentration at height z (mg/m^3)					

ADD W/ INT. 1

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) 1982 1-HOUR NO BUILD

Project No.: 2026.01 Analyst R. L.

Site: No Ketplace Center Date: 6/15/82

Receptor 2

Step	Symbol	Input/Units	300°			285°			Traffic Stream 270°			255°	
		Basic inputs	N Comm	SB UA	NB UA	N Comm	SB UA	NB UA	N Comm	SB UA	NB UA	SB UA	N UA
1	SC	Stability class	D	D	D	D	D	D	D	D	D	D	
2	U	Wind speed (m s^{-1})	1	1	1	1	1	1	1	1	1	1	
3	θ	Wind/road angle (deg)	57	11	11	72	26	26	87	41	41	26	
4		Sin θ	.84	.19	.19	.95	.44	.44	1.0	.66	.66	.44	
5	x	Road receptor distance (m)	149	81	66	149	81	66	149	81	66	81	
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	5	
7	Q	Emission rate (g m^{-1} s^{-1})	.007	.011	.016	.007	.011	.016	.007	.011	.016	.011	
7a		Street canyon? (yes or no)					—						
		Dispersion computation											
8	xU/Q	Normalized concentration (10^{-3} m^{-1})	170	220	250	160	180	180	80	130	140	180	
9	xU	Normalized concentration (mg m^{-2} s^{-1})	1.2	2.4	4.0	1.1	2.0	2.9	0.6	1.4	2.2	2.0	
10	x	CO concentration (mg m^{-3})	1.2	2.4	4.0	1.1	2.0	2.9	0.6	1.4	2.2	2.0	
11	x	CO concentration (ppm)	1.0	2.1	3.5	1.0	1.7	2.5	0.5	1.2	2.0	1.7	
				6.6			5.2			3.7		4.2	
		Optional z-correction (heights other than 1.8 m above ground)											
12	z	Height receptor (m)					—	—	—	—			
13		z-correction factor					—	—	—	—			

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following)

1982 8-HOUR NO BUILD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 6/29/82

Symbol	Input/Units	Traffic Stream			
i	Road segment (or approach identification)	UA-B	UA NB	Comm N	State
V_i	Demand volume (vph)	722	627	240	527
C_i	Free-flow capacity (vph)				
S_i	Cruise speed (mph)	20	25	25	25
Ef_i	Free-flow emissions (g/veh-m)	.048	.038	.038	.038
N_i	Number of lanes in approach i				
j	Signalized intersections phase identification				
$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)				
$V_{i,j}$	Demand volume for approach i, phase j (vph)				
C_y	Signal cycle length (s)				
$G_{i,j}$	Green phase length for approach i, phase j (s)				
C_i	Capacity of approach i (vph)				
$P_{i,j}$	Proportion of vehicles that stop				
$N_{i,j}$	Number of vehicles that stop per signal cycle				
N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase				
Lq_i	Length of vehicle queue for approach i (veh-m/lane)				
$\bar{x}_i$	Average excess running time on approach (s/veh)				
Ea_i	Excess emissions from acceleration (g/veh-m)				
Ed_i	Excess emissions from deceleration (g/veh-m)				
Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)				
Lad_i	Length of acceleration and deceleration (m)				
Le_i	Length over which excess emissions apply (m)				
Fs_i	Average idle emission rate (g/s)				
Qe	Average excess emission rate (g/m-s)				
Qe_i	Adjusted excess emission rate (g/s-m)				
Qfc_i	Free-flow emission rate (g/s-m)	.010	.007	.002	.006

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) ADD w/ INT 2

Project No.: 2026.01 Analyst R. Longley 1982 8-HOUR NO BUILD

Site: Marketplace Center Date: 6/29/82

RECEPTOR 1

Step	Symbol	Input/Units	120°			135°			150°			
		Basic inputs	UAse	State	CommN	UAse	State	CommN	UAse	State	CommN	
1	SC	Stability class	D	D	D	D	D	D	D	D	D	
2	U	Wind speed ($m\ s^{-1}$)	3	3	3	3	3	3	3	3	3	
3	θ	Wind/road angle (deg)	47	40	55	32	55	40	17	70	25	
4		Sin θ	.73	.64	.82	.53	.82	.64	.30	.94	.42	
5	x	Road receptor distance (m)	73	106	9	73	106	9	73	101	9	
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	
7	Q_o	Emission rate ($g\ m^{-1}\ s^{-1}$)	.010	.007	.002	.010	.007	.002	.010	.007	.002	
7a		Street canyon? (yes or no)		NO			NO			NO		
		Dispersion computation										
8	χU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	120	105	170	160	95	210	205	80	310	
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.2	0.7	0.3	1.6	0.7	0.4	2.0	0.6	0.6	
10	χ	CO concentration ($mg\ m^{-3}$)	0.4	0.2	0.1	0.5	0.2	0.1	0.7	0.2	0.2	
11	χ	CO concentration (ppm)	0.4	0.2	0.1	0.5	0.2	0.1	0.6	0.2	0.2	
				0.7			0.8			1.0		
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)				—	—	—	—			
13		z-correction factor				—	—	—	—			
14	χ'	CO concentration at height z (mg/m^3)				—	—	—	—			
15	χ'	CO concentration at height z (ppm)				—	—	—	—			

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) Add w/ INT. 2

Project No.: 2026.01 Analyst R. Longley

Site: Marketplace Center Date: 6/29/82

1982 8-HOUR NO BUILD

RECEPTOR 1

Step	Symbol	Input/Units	165°											
		Basic inputs	UA-8	State	Comm'N									
1	SC	Stability class	D	D	D									
2	U	Wind speed ($m\ s^{-1}$)	3	3	3									
3	θ	Wind/road angle (deg)	2	85	10									
4		Sin θ	.03	1.00	.17									
5	x	Road receptor distance (m)	73	106	9									
6	σ_{z_o}	Initial dispersion (m)	5	5	5									
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.010	007	.002									
7a		Street canyon? (yes or no)		NO										
		Dispersion computation												
8	$\chi U/Q$	Normalized concentration ($10^{-3}\ m^{-1}$)	190	80	630									
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.9	0.6	1.3									
10	χ	CO concentration ($mg\ m^{-3}$)	0.6	0.2	0.4									
11	χ	CO concentration (ppm)	0.6	0.2	0.4									
				1.2										
		Optional z-correction (heights other than 1.8 m above ground)												
12	z	Height receptor (m)												
13		z-correction factor												
14	χ'	CO concentration at height z (mg/m^3)												
15	χ'	CO concentration at height z (ppm)												

Project No.: 2026.01 Analyst R. Longley ADD W/ INT. 2

Site: Marketplace Center Date: 6/29/82

1982 8-HOUR NO BUILD

RECEPTOR 2

Step	Symbol	Input/Units	165°			180°			195°			
		Basic inputs	Base	Alt	State	Base	Alt	State	Base	Alt	State	
1	SC	Stability class	D	D	D	D	D	D	D	D	D	
2	U	Wind speed ($m\ s^{-1}$)	3	3	3	3	3	3	3	3	3	
3	θ	Wind/road angle (deg)	15	15	90	30	30	75	45	45	60	
4		Sin θ	.26	.26	1.00	.50	.50	.97	.71	.71	.87	
5	x	Road receptor distance (m)	82	67	91	82	67	91	82	67	91	
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.010	.007	.006	—	.007	.006	—	.007	.006	
7a		Street canyon? (yes or no)		NO			NO			NO		
		Dispersion computation										
8	χU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	200	245	90	160	175	90	130	145	106	
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	12.0	1.7	0.5	1.6	1.2	0.5	1.3	1.0	0.6	
10	x	CO concentration ($mg\ m^{-3}$)	0.7	0.6	0.2	0.5	0.4	0.2	0.4	0.3	0.2	
11	x	CO concentration (ppm)	0.6	0.5	0.2	0.5	0.4	0.2	0.4	0.3	0.2	
				1.3			1.1			0.9		
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor				—	—	—	—			
14	x'	CO concentration at height z (mg/m^3)				—	—	—	—			
15	x'	CO concentration at height z (ppm)				—	—	—	—			

Project No.: 2016.01 Analyst R. Longley

Site: MarKelplace Center Date: 6/29/82

Had w/ Lvl 1

1982 8-HOUR NO BUILD

Receptor 1

Step	Symbol	Input/Units	30° Comm N	30° UA SB	15° Comm N	15° UA SB	0° Comm N	0° UA SB				
		Basic inputs										
1	SC	Stability class	D	D	D	D	D	D				
2	U	Wind speed ($m\ s^{-1}$)	3	3	3	3	3	3				
3	θ	Wind/road angle (deg)	35	79	20	64	5	45				
4		Sin θ	.57	1.0	.35	.90	.09	.85				
5	x	Road receptor distance (m)	9	70	9	70	9	70				
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5				
7	Q_o	Emission rate ($g\ m^{-1}\ s^{-1}$)	.002	.010	.002	.010	.002	.010				
7a		Street canyon? (yes or no)	NO		NO		NO					
		Dispersion computation										
8	χU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	240	105	350	110	800	140				
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	0.5	1.0	0.7	1.1	1.6	1.4				
10	χ	CO concentration ($mg\ m^{-3}$)	0.2	0.4	0.2	0.4	0.5	0.5				
11	χ	CO concentration (ppm)	0.1	0.3	0.2	0.3	0.5	0.4				
			0.4		0.5		0.9					
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor										
14	χ'	CO concentration at height z (mg/m^3)										
15	χ'	CO concentration at height z (ppm)										

Add w/ INT. 1

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst R.L. 1982 8-HOUR NO BUILD

Site: Marketplace Center Date: 6/29/82

Receptor 2

Step	Symbol	Input/Units	300° Comm N	300° UA SB	300° UA NB	285° Comm N	285° UA SB	285° UA NB	270° Comm N	270° UA SB	270° UA NB	255° UA SB	255° UA NB
		Basic inputs											
1	SC	Stability class	D	D	D	D	D	D	D	D	D	D	D
2	U	Wind speed (m s^{-1})	3	3	3	3	3	3	3	3	3	3	3
3	θ	Wind/road angle (deg)	57	11	11	72	26	26	87	41	41	26	26
4		Sin θ	.84	.19	.19	.95	.44	.44	1.0	.66	.66	.44	.44
5	x	Road receptor distance (m)	149	81	66	149	81	66	149	81	66	81	66
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	5	5
7	Q	Emission rate (g m^{-1} s^{-1})	.002	.010	.007	.002	.010	.007	.002	.010	.007	.010	.007
7a		Street canyon? (yes or no)		NO			NO			NO			
		Dispersion computation											
8	xU/Q	Normalized concentration (10^{-3} m^{-1})	170	220	250	160	190	180	80	130	140	180	180
9	xU	Normalized concentration (mg m^{-2} s^{-1})	0.3	2.2	1.8	0.3	1.8	1.3	0.2	1.3	1.0	1.8	1.3
10	x	CO concentration (mg m^{-3})	0.1	0.7	0.6	0.1	0.6	0.4	0.1	0.4	0.3	0.6	0.4
11	x	CO concentration (ppm)	0.1	0.6	0.5	0.1	0.5	0.4	0.05	0.4	0.3	0.5	0.4
				1.2			1.0			1.2		0.9	
		Optional z-correction (heights other than 1.8 m above ground)											
12	z	Height receptor (m)											
13		z-correction factor											
14	x'	CO concentration at height z (mg/m^3)											
15	x'	CO concentration at height z (ppm)											

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following) 1987 1-Hour No Build

Project No.: 2026.01 Analyst: Ripley

Site: Marketplace Center Date: 6/21/88

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UASB	UANB	CmrN	State
2	V_i	Demand volume (vph)	671	980	281	476
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	15	25
5	Ef_i	Free-flow emissions (g/veh-m)	.039	.039	.058	.039
6.1	H_i	Number of lanes in approach i				
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)				
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)				
6.5	C_y	Signal cycle length (s)				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)				
6.7	C_i	Capacity of approach i (vph)				
6.8	$P_{i,j}$	Proportion of vehicles that stop				
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle				
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase				
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)				
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	Excess emissions from acceleration (g/veh-m)				
11	Ed_i	Excess emissions from deceleration (g/veh-m)				
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average excess emission rate (g/m-s)				
17	Qe'_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)	.007	.011	.004	.005

ADD W/ INT. 2

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst R. Langley 1987 1-HOUR

Site: Marketplace Center Date: 6/21/82 NO BUILD

Receptor 1

Step	Symbol	Input/Units	90°			105°			120°		
		Basic inputs	UAM	State	CommN	UAM	State	CommN	UAM	State	CommN
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	77	10	85	62	25	70	47	40	55
4		Sin θ	.97	.17	1.00	.88	.42	.94	.73	.64	.82
5	x	Road receptor distance (m)	73	106	9	73	106	9	73	106	9
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.007	.005	.004	.007	.005	.004	.007	.005	.004
7a		Street canyon? (yes or no)	NO				NO		NO		
		Dispersion computation									
8	$\chi U/Q$	Normalized concentration ($10^{-3}\ m^{-1}$)	100	180	150	105	150	160	120	105	170
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	0.7	0.9	0.6	0.7	0.8	0.6	0.8	0.5	0.7
10	χ	CO concentration ($mg\ m^{-3}$)	0.7	0.9	0.6	0.7	0.8	0.6	0.8	0.5	0.7
11	χ	CO concentration (ppm)	0.6	0.8	0.5	0.6	0.6	0.6	0.7	0.5	0.6
					1.9			1.8			1.8
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)									
13		z-correction factor									
14	χ'	CO concentration at height z (mg/m^3)									
15	χ'	CO concentration at height z (ppm)									

ADD W/ INT. 2

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst R. Longley 1987 1-HOUR

Site: Marketplace Center Date: 6/21/82 NO BUILD

Receptor 1

Step	Symbol	Input/Units	135°			150°			165°		
		Basic inputs	UAsb	State	Comm	UAsb	State	Comm	UAsb	State	Comm
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	32	55	40	17	70	25	2	85	10
4		Sin θ	.53	.82	.64	.30	.94	.42	.03	1.00	.17
5	x	Road receptor distance (m)	73	106	9	73	106	9	73	106	9
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.007	.005	.004	.007	.005	.004	.007	.005	.004
7a		Street canyon? (yes or no)		NO			NO			NO	
		Dispersion computation									
8	$\chi U/Q$	Normalized concentration ($10^{-3}\ m^{-1}$)	160	95	210	205	80	310	190	80	630
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.1	0.5	0.8	1.4	0.4	1.2	1.3	0.4	2.5
10	χ	CO concentration ($mg\ m^{-3}$)	1.1	0.5	0.8	1.4	0.4	1.2	1.3	0.4	2.5
11	χ	CO concentration (ppm)	1.0	0.4	0.7	1.2	0.4	1.1	1.2	0.4	2.2
				2.1			2.7			3.8	
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)									
13		z-correction factor									
14	χ'	CO concentration at height z (mg/m^3)									
15	χ'	CO concentration at height z (ppm)									

ADD w/ INT. 2

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst R. Loxley 1987 1-HOUR

Site: Marketplace Center Date: 6/21/82 NO BUILD

Receptor 2

Step	Symbol	Input/Units	165°			180°			195°		
		Basic inputs	UASB	UANB	State	UASB	UANB	State	UASB	UANB	State
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	15	15	90	30	30	75	45	45	60
4		Sin θ	.26	.26	1.00	.50	.50	.97	.71	.71	.87
5	x	Road receptor distance (m)	82	67	91	82	67	91	82	67	91
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.007	.011	.005	.007	.011	.005	.007	.011	.005
7a		Street canyon? (yes or no)		NO			NO			NO	
		Dispersion computation									
8	$\chi U/Q$	Normalized concentration ($10^{-3}\ m^{-1}$)	200	245	90	160	175	90	130	145	100
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.4	2.7	0.4	1.1	1.9	0.4	0.9	1.6	0.5
10	χ	CO concentration ($mg\ m^{-3}$)	1.4	2.7	0.4	1.1	1.9	0.4	0.9	1.6	0.5
11	χ	CO concentration (ppm)	1.2	2.3	0.4	1.0	1.7	0.4	0.8	1.4	0.4
				3.9			3.1			3.6	
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)									
13		z-correction factor									
14	χ'	CO concentration at height z (mg/m^3)									
15	χ'	CO concentration at height z (ppm)									

ADD W/ INT. 2

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst R. Longley 1987 1-HOUR

Site: Marketplace Center Date: 6/21/82 NO BUILD

Receptor 2

Step	Symbol	Input/Units	210°			225°			240°		
		Basic inputs	UA_{SB}	UA_{NB}	State	UA_{SB}	UA_{NB}	State	UA_{SB}	UA_{NB}	State
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	60	60	45	75	75	30	90	90	15
4		Sin θ	.87	.87	.71	.97	.97	.50	1.0	1.0	.26
5	x	Road receptor distance (m)	82	67	91	82	67	91	82	67	91
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.007	.011	.005	.007	.011	.005	.007	.011	.005
7a		Street canyon? (yes or no)		NO			NO			NO	
		Dispersion computation									
8	$\chi U/Q$	Normalized concentration ($10^{-3}\ m^{-1}$)	105	120	120	95	110	150	95	105	200
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	0.7	1.3	0.6	0.7	1.2	0.8	0.7	1.2	1.0
10	χ	CO concentration ($mg\ m^{-3}$)	0.7	1.3	0.6	0.7	1.2	0.8	0.7	1.2	1.0
11	χ	CO concentration (ppm)	0.6	1.1	0.5	0.6	1.0	0.6	0.6	1.0	0.9
				2.2			2.2			2.5	
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)									
13		z-correction factor									
14	χ'	CO concentration at height z (mg/m^3)									
15	χ'	CO concentration at height z (ppm)									

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) ADD W/ INT. 1

Project No.: 2026.01 Analyst R. Longley 1987 1-Hour

Site: Marketplace Center Date: 6/21/82 No Build

Receptor 1

Step	Symbol	Input/Units	75° Comm N	75° UA SB	75° UA NB	60° Comm N	60° UA SB	45° Comm N	45° UA SB	30° Comm N	30° UA SB	
		Basic inputs										
1	SC	Stability class	D	D	D	D	D	D	D	D	D	
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1	
3	θ	Wind/road angle (deg)	80	56	56	65	71	50	86	35	79	
4		Sin θ	.98	.83	.83	.91	.95	.78	1.0	.57	1.0	
5	x	Road receptor distance (m)	9	70	85	9	70	9	70	9	70	
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.004	.007	.011	.004	.007	.004	.007	.004	.007	
7a		Street canyon? (yes or no)		NO			NO	NO		NO		
		Dispersion computation										
8	χU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	150	120	110	170	100	180	105	240	105	
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	0.6	0.8	1.2	0.7	0.7	0.7	0.7	1.0	0.7	
10	χ	CO concentration ($mg\ m^{-3}$)	0.6	0.8	1.2	0.7	0.7	0.7	0.7	1.0	0.7	
11	χ	CO concentration (ppm)	0.5	0.7	1.0	0.6	0.6	0.6	0.6	0.8	0.6	
				2.2		1.2		1.2		1.4		
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor										
14	x'	CO concentration at height z (mg/m^3)										
15	x'	CO concentration at height z (ppm)										

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) ADD W/ INT 1

Project No.: 2026.01 Analyst R. Langley

Site: Marketplace Center Date: 6/21/82

1987 1-Hour NO BUILD

RECEPTOR 1

Step	Symbol	Input/Units	15° Comm N	15° UA SB	0° Comm N	0° UA SB
		Basic inputs				
1	SC	Stability class	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1
3	θ	Wind/road angle (deg)	20	64	5	45
4		Sin θ	.35	.96	.09	.85
5	x	Road receptor distance (m)	9	70	9	70
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.004	.007	.004	.007
7a		Street canyon? (yes or no)				
		Dispersion computation				
8	$\chi U/Q$	Normalized concentration ($10^{-3}\ m^{-1}$)	350	110	800	140
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.4	0.8	3.2	1.0
10	χ	CO concentration ($mg\ m^{-3}$)	1.4	0.8	3.2	1.0
11	χ	CO concentration (ppm)	1.2	0.7	2.8	0.8
			1.9		3.6	
		Optional z-correction (heights other than 1.8 m above ground)				
12	z	Height receptor (m)				
13		z-correction factor				
14	χ'	CO concentration at height z (mg/m^3)				
15	χ'	CO concentration at height z (ppm)				

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) ADD W/ INT. 1

Project No.: 2026.01 Analyst R. Langley 1987 1-HOUR

Site: Marketplace Center Date: 6/21/82 NO BUILD

Receptor 2

Step	Symbol	Input/Units	300° Comm N	300° UA SB	300° UA NB	285° Comm N	285° UA SB	285° UA NB	270° Comm N	270° UA SB	270° UA NB	255° UA SB	255° UA NB
		Basic inputs											
1	SC	Stability class	D	D	D	D	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	1	1	1	1	1	1	1	1	1	1	1
3	θ	Wind/road angle (deg)	57	11	11	72	26	26	87	41	41	26	26
4		Sin θ	.84	.19	.19	.95	.44	.44	1.0	.66	.66	.44	.44
5	x	Road receptor distance (m)	149	81	66	149	81	66	149	81	66	81	66
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.004	.007	.011	.004	.007	.011	.004	.007	.011	.007	.011
7a		Street canyon? (yes or no)		NO			NO						
		Dispersion computation											
8	χU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	170	220	250	160	180	180	80	130	140	180	180
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	0.7	1.5	2.8	0.6	1.3	2.0	0.3	0.9	1.5	1.3	2.0
10	χ	CO concentration ($mg\ m^{-3}$)	0.7	1.5	2.8	0.6	1.3	2.0	0.3	0.9	1.5	1.3	2.0
11	χ	CO concentration (ppm)	0.6	1.3	2.4	0.6	1.1	1.7	0.3	0.8	1.3	1.1	1.7
				4.3			3.4			2.4		2.8	
		Optional z-correction (heights other than 1.8 m above ground)											
12	z	Height receptor (m)											
13		z-correction factor											
14	χ'	CO concentration at height z (mg/m^3)											
15	χ'	CO concentration at height z (ppm)											

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following)

1987 8-HOUR NO BUILD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/7/82

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UAsb	UAnb	Comm'l	State
2	V_i	Demand volume (vph)	739	642	242	538
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)	.026	.026	.026	.026
6.1	N_i	Number of lanes in approach i				
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)				
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)				
6.5	C_y	Signal cycle length (s)				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)				
6.7	C_i	Capacity of approach i (vph)				
6.8	$P_{i,j}$	Proportion of vehicles that stop				
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle				
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase				
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)				
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	Excess emissions from acceleration (g/veh-m)				
11	Ed_i	Excess emissions from deceleration (g/veh-m)				
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average excess emission rate (g/m-s)				
17	Oe'_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)	.002	.005	.005	.001

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) Add W/ ENT. 2

Project No.: 2026.01 Analyst RL

Site: Marketplace Center Date: 7/7/82

1987 8-HOUR NO BUILD

RECEPTOR 1

Step	Symbol	Input/Units	135°			150°			165°		
		Basic inputs	UAsb	UAwb	Comm	UAsb	UAwb	Comm	UAsb	UAwb	Comm
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed ($m\ s^{-1}$)	3	3	3	3	3	3	3	3	3
3	θ	Wind/road angle (deg)	~~32~~	~~55~~	~~74~~	~~17~~	70	25	2	85	16
4		Sin θ	~~.53~~	~~.64~~	~~.64~~	.3	.94	.42	.03	1.00	.17
5	x	Road-receptor distance (m)	~~73~~	~~106~~	~~59~~	73	106	9	73	106	9
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.002	.005	.005	.002	.005	.005	.002	.005	.005
7a		Street canyon? (yes or no)					—				
		Dispersion computation									
8	χU/Q	Normalized concentration ($10^{-3}\ m^{-1}$)	160	95	210	205	80	310	190	80	630
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	0.3	0.5	1.0	0.4	0.4	1.6	0.4	0.4	3.2
10	χ	CO concentration ($mg\ m^{-3}$)	0.1	0.2	0.4	0.1	0.1	0.5	0.1	0.1	1.0
11	χ	CO concentration (ppm)	0.1	0.2	.3	0.1	0.1	0.4	0.1	0.1	0.9
				0.6			0.6			1.1	
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)				—	—	—	—	—	—
13		z-correction factor				—	—	—	—	—	—
14	x'	CO concentration at height z (mg/m^3)				—	—	—	—	—	—
15	x'	CO concentration at height z (ppm)				—	—	—	—	—	—

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) Add w/ Int. 2

Project No.: 2026.01 Analyst RL

Site: Marketplace Center Date: ~~7/7/82~~ 7/7/82

1987 8-HAR NO BUILD

Receptor 2

Step	Symbol	Input/Units	165° UAsb	165° UAnb	165° State	180° UAsb	180° UAnb	180° State				
		Basic inputs										
1	SC	Stability class	D	D	D	D	D	D				
2	U	Wind speed (m s^{-1})	3	3	3	3	3	3				
3	θ	Wind/road angle (deg)	15	15	90	30	30	75				
4		Sin θ	.26	.26	1.0	.5	.5	.97				
5	x	Road receptor distance (m)	82	67	91	82	67	91				
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5				
7	Q	Emission rate (g m^{-1} s^{-1})	.002	.005	.001	.002	.005	.001				
7a		Street canyon? (yes or no)		NO			NO					
		Dispersion computation										
8	$\chi U/Q$	Normalized concentration (10^{-3} m^{-1})	200	245	90	166	175	90				
9	χU	Normalized concentration (mg m^{-2} s^{-1})	0.4	1.2	.09	0.3	0.9	.09				
10	χ	CO concentration (mg m^{-3})	0.1	0.4	.03	0.1	0.3	.03				
11	χ	CO concentration (ppm)	0.1	0.4	.03	0.1	0.2	.03				
				0.5			0.3					
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor										
14	χ'	CO concentration at height z (mg/m^3)										
15	χ'	CO concentration at height z (ppm)										

70

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Add w/ INT 1

Project No.: 2026.01 Analyst RL

Site: Marketplace Center Date: 7/7/82

1982 8-HOUR NO BUILD

RECEPTOR 1

Step	Symbol	Input/Units	0° Comm N	0° UA SB
		Basic inputs		
1	SC	Stability class	D	D
2	U	Wind speed (m s^{-1})	3	3
3	θ	Wind/road angle (deg)	5	45
4		Sin θ	.09	.85
5	x	Road receptor distance (m)	9	70
6	σ_{z_o}	Initial dispersion (m)	5	5
7	Q	Emission rate (g m^{-1} s^{-1})	.005	.002
7a		Street canyon? (yes or no)		
		Dispersion computation		
8	χU/Q	Normalized concentration (10^{-3} m^{-1})	800	140
9	χU	Normalized concentration (mg m^{-2} s^{-1})	4.0	0.3
10	χ	CO concentration (mg m^{-3})	1.3	0.1
11	χ	CO concentration (ppm)	1.2	0.1
			1.3	
		Optional z-correction (heights other than 1.8 m above ground)		
12	z	Height receptor (m)		
13		z-correction factor		
14	χ'	CO concentration at height z (mg/m^3)		
15	χ'	CO concentration at height z (ppm)		

Add w/ Int 1

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Project No.: 2026.01 Analyst RI

Site: Marketplace Center Date: 7/7/82

1987 8-HOUR NO BUILD

RECEPTOR 2

Step	Symbol	Input/Units	300° Comm N	300° UA SB	300° UA NB	285° Comm N	285° UA SB	285° UA NB	270° Comm N	270° UA SB	270° UA NB
		Basic inputs									
1	SC	Stability class	D	D	D	D	D	D	D	D	D
2	U	Wind speed (m s^{-1})	3	3	3	3	3	3	3	3	3
3	θ	Wind/road angle (deg)	57	11	11	72	26	26	87	41	41
4		Sin θ	.84	.19	.19	.95	.44	.44	1.0	0.7	0.7
5	x	Road receptor distance (m)	149	81	66	149	81	66	149	81	66
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5
7	Q	Emission rate (g m^{-1} s^{-1})	.005	.002	.005	.005	.002	.005	.005	.002	.005
7a		Street canyon? (yes or no)					—				
		Dispersion computation									
8	$\chi U/Q$	Normalized concentration (10^{-3} m^{-1})	170	220	250	160	180	180	80	130	140
9	χU	Normalized concentration (mg m^{-2} s^{-1})	0.8	0.4	1.2	0.8	0.4	0.9	0.4	0.3	0.7
10	χ	CO concentration (mg m^{-3})	0.3	0.2	0.4	0.3	0.1	0.3	0.1	0.1	0.2
11	χ	CO concentration (ppm)	0.2	0.1	0.4	0.2	0.1	0.3	0.1	0.1	0.2
				0.7			0.6			0.4	
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)				—	—		—	—	
13		z-correction factor				—	—		—	—	
14	χ'	CO concentration at height z (mg/m^3)				—	—		—	—	
15	χ'	CO concentration at height z (ppm)				—	—		—	—	

Freeflow

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following) 1997 1-HOUR EDMD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/2/92

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UA SB	UA NB	State	
2	V_i	Demand volume (vph)	568	1005	469	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	10	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.039	.076	.039	
6.1	M_i	Number of lanes in approach i				
6.2	J	Signalized intersections phase identification				
6.3	$Cs_{i,J}$	Capacity service volume of approach i for phase j (vph of green)				
6.4	$V_{i,J}$	Demand volume for approach i, phase j (vph)				
6.5	C_y	Signal cycle length (s)				
6.6	$G_{i,J}$	Green phase length for approach i, phase j (s)				
6.7	C_i	Capacity of approach i (vph)				
6.8	$P_{i,J}$	Proportion of vehicles that stop				
6.9	$N_{i,J}$	Number of vehicles that stop per signal cycle				
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase				
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)				
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	Excess emissions from acceleration (g/veh-m)				
11	Ed_i	Excess emissions from deceleration (g/veh-m)				
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average excess emission rate (g/m-s)				
17	Qe'_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)	.006	.021	.005	

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) ADD W/INT2

Project No.: 2026.01 Analyst RL

Site: Marketplace Center Date: 7/8/82

1987 1-HOUR BUILD

RECEPTOR 2

Step	Symbol	Input/Units	165°			180°			195°			
		Basic inputs	UAsb	UAnb	State	UAsb	UAnb	State	UAsb	UAnb	State	
1	SC	Stability class	D	D	D	D	D	D	D	D	D	
2	U	Wind speed (m s^{-1})	1	1	1	1	1	1	1	1	1	
3	θ	Wind/road angle (deg)	15	15	90	30	30	75	45	45	60	
4		Sin θ	.26	.26	1.00	.50	.50	.97	.71	.71	.87	
5	x	Road receptor distance (m)	82	67	91	82	67	91	82	67	91	
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5	5	
7	Q	Emission rate (g m^{-1} s^{-1})	.006	.021	.005	.006	.021	.005	.006	.021	.005	
7a		Street canyon? (yes or no)					—					
		Dispersion computation										
8	χU/Q	Normalized concentration (10^{-3} m^{-1})	200	245	90	160	175	90	130	145	100	
9	χU	Normalized concentration (mg m^{-2} s^{-1})	1.2	5.2	0.4	1.0	3.7	0.4	0.8	3.0	0.5	
10	χ	CO concentration (mg m^{-3})	1.2	5.2	0.4	1.0	3.7	0.4	0.8	3.0	0.5	
11	χ	CO concentration (ppm)	1.0	4.5	0.4	0.8	3.2	0.4	0.7	2.6	0.4	
				5.9			4.4			3.7		
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)					—					
13		z-correction factor					—					
14	χ'	CO concentration at height z (mg/m^3)					—					
15	χ'	CO concentration at height z (ppm)					—					

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) Add w/ INT #

Project No.: 2026.01 Analyst RL

Site: Marketplace Center Date: 7/8/87 1987 / HALE BUILD

Receptor #

Step	Symbol	Input/Units	300°		285°		270°		255°			
		Basic inputs	VA_{SB}	VA_{NB}	VA_{SB}	VA_{NB}	VA_{SB}	VA_{NB}	VA_{SB}	VA_{NB}		
1	SC	Stability class	D	D	D	D	D	D	D	D		
2	U	Wind speed (m s^{-1})	1	1	1	1	1	1	1	1		
3	θ	Wind/road angle (deg)	11	11	26	26	41	41	26	26		
4		Sin θ	.19	.19	.44	.44	.66	.66	.44	.44		
5	x	Road receptor distance (m)	81	66	81	66	81	66	81	66		
6	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5	5	5	5		
7	Q	Emission rate (g m^{-1} s^{-1})	.006	.021	.006	.021	.006	.021	.006	.021		
7a		Street canyon? (yes or no)										
		Dispersion computation										
8	$\chi U/Q$	Normalized concentration (10^{-3} m^{-1})	220	250	180	180	130	140	180	180		
9	χU	Normalized concentration (mg m^{-2} s^{-1})	1.3	5.2	1.1	3.8	0.8	2.9	1.1	3.8		
10	χ	CO concentration (mg m^{-3})	1.3	5.2	1.1	3.8	0.8	2.9	1.1	3.8		
11	χ	CO concentration (ppm)	1.2	4.6	0.9	3.3	0.7	2.6	0.9	3.3		
			5.8		4.2		3.3		4.2			
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor										
14	χ'	CO concentration at height z (mg/m^3)										
15	χ'	CO concentration at height z (ppm)										

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION (see instructions following) 1987 3-FOUR BOND

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/12/82

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	UAse	UAnb	State	
2	V_i	Demand volume (vph)	687	789	471	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	20	25	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.036	.026	.036	
6.1	M_i	Number of lanes in approach i				
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)				
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)				
6.5	C_y	Signal cycle length (s)				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)				
6.7	C_i	Capacity of approach i (vph)				
6.8	$P_{i,j}$	Proportion of vehicles that stop				
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle				
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase				
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)				
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	Excess emissions from acceleration (g/veh-m)				
11	Ed_i	Excess emissions from deceleration (g/veh-m)				
12	Qad_i	Excess emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average excess emission rate (g/m-s)				
17	Qe'_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)	.007	.006	.003	

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following) Add w/ INT 2

Project No.: 2026.01 Analyst RI 1987 8-HOUR 1

Site: Marketplace Center Date: 7/12/82 BUILD

Receptor 2

Step	Symbol	Input/Units	180°				165°					
		Basic inputs	UNB	UAVG	State		UNB	UAVG	State			
1	SC	Stability class	D	D	D		D	D	D			
2	U	Wind speed ($m\ s^{-1}$)	3	3	3		3	3	3			
3	θ	Wind/road angle (deg)	30	30	75		15	15	90			
4		Sin θ	.5	.5	.97		.26	.26	1.0			
5	x	Road receptor distance (m)	82	67	91		82	67	91			
6	σ_{z_o}	Initial dispersion (m)	5	5	5		5	5	5			
7	Q	Emission rate ($g\ m^{-1}\ s^{-1}$)	.007	.006	.003		.007	.006	.003			
7a		Street canyon? (yes or no)										
		Dispersion computation										
8	$\chi U/Q$	Normalized concentration ($10^{-3}\ m^{-1}$)	160	175	90		200	245	90			
9	χU	Normalized concentration ($mg\ m^{-2}\ s^{-1}$)	1.1	1.1	0.3		1.4	1.5	0.3			
10	χ	CO concentration ($mg\ m^{-3}$)	0.4	0.4	0.1		0.5	0.5	0.1			
11	χ	CO concentration (ppm)	0.3	0.3	0.1		0.4	0.4	0.1			
			0.7				0.9					
		Optional z-correction (heights other than 1.8 m above ground)										
12	z	Height receptor (m)										
13		z-correction factor										
14	χ'	CO concentration at height z (mg/m^3)										
15	χ'	CO concentration at height z (ppm)										

WORKSHEET 4--INFINITE LINE SOURCE CO DISPERSION ANALYSIS (see instructions following)

Add w/ INT 1

Project No.: 2026.01 Analyst RL

1987 8-HOUR BUILD

Site: Wellington Place Center Date: 7/12/82

Step	Symbol	Input/Units	270°								
		Basic inputs	UA_{SB}	UA_{NB}							
1	SC	Stability class	D	D							
2	U	Wind speed (m s^{-1})	3	3							
3	θ	Wind/road angle (deg)	41	41							
4		Sin θ	.66	.66							
5	x	Road receptor distance (m)	81	66							
6	σ_{z_o}	Initial dispersion (m)	5	5							
7	Q	Emission rate (g m^{-1} s^{-1})	.007	.006							
7a		Street canyon? (yes or no)									
		Dispersion computation									
8	$\chi U/Q$	Normalized concentration (10^{-3} m^{-1})	130	140							
9	χU	Normalized concentration (mg m^{-2} s^{-1})	0.9	0.8							
10	χ	CO concentration (mg m^{-3})	0.3	0.3							
11	χ	CO concentration (ppm)	0.3	0.2							
			0.5								
		Optional z-correction (heights other than 1.8 m above ground)									
12	z	Height receptor (m)									
13		z-correction factor									
14	χ'	CO concentration at height z (mg/m^3)									
15	χ'	CO concentration at height z (ppm)									

APPENDIX G

AREA SOURCE ANALYSIS

Worksheet 1 1982 1-Hour No Build

TRAFFIC INFORMATION USED IN THE APPLICATION OF THE EVALUATION PROCEDURE

1.	Roadway segment or intersection approach identification	
2.	Observed 1-hr volume (vph)	
	Observed 8-hr volume (vph)	
	Projected 1-hr peak demand (vph)	
	Projected 8-hr peak demand (vph)	
3.	Percentage cold starts	
4.	Percentage trucks and buses	
5.	Metropolitan population	
6.	Slope	
7.	Free-flow parameters	
	Number of lanes	
	Average lane width (ft)	
	Design speed (mph)	
	Highway type (see Figures 2-5)	
8.	Intersection parameters	
	Intersection designation	
	Approach width (ft)	
	Percentage right turns	
	Percentage left turns	
	Type control and description of signal controller	
9.	Area source parameters	
	Parking lot gate designation	1
	Projected 1-hr peak entrance demand (vph)	101
	Projected 1-hr peak exit demand (vph)	114
	Projected 8-hr peak entrance demand (vph)	
	Projected 8-hr peak exit demand (vph)	
	Parking lot area (m^2)	6061
	Parking lot capacity (veh)	179
	Running time required to access auxiliary parking (s)	-
	Facility emptying time	-
	Average cars per stall	-
	Average area per stall (m^2)	1

1992 1-HOUR
NO BUILD

WORKSHEET 3--AREA SOURCE EMISSIONS COMPUTATION
(see instructions following)

Project No.: 2026.01 Analyst: R. Lixey

Site: Marketplace Center Date: 6/21/92

Step	Symbol	Input/Units				
1	Brt	Base running time	-			
1.1		Base approach time(s)				
1.2		Base entrance time(s)				
1.3		Base movement-in time(s)				
1.4		Base stop, base start time(s)				
1.5		Base movement-out time(s)				
1.6		Base exit time(s)				
1.7		Base departure time(s)				
1.8		Total base running time(s)	131.			
2	A	Area of parking lot (m^2)	6061			
3	i	Entrance approach identification	1			
4	Ve_i	Entrance demand volume (vph)	101			
5	Ce_i	Entrance approach capacities (vph)	240.			
6	i	Exit approach identification	1			
7	Vx_i	Exit demand volume (vph)	114			
8	Cx_i	Exit approach capacities (vph)	120			
9		Number of parking spaces occupied	179			
10	F	Emissions	.178			
11	Pc	Capacity of parking lot (veh)	179			
12	Rmi	Excess movement-in time(s)	345			
13	Fet	Facility emptying time(s)	3600			
14		Excess running time	-			
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio	.42			
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio	.63			
14.3	Re_i	Excess running time entering parking lot	10			
14.4	Rx_i	Excess running time exiting parking lot	34			
15	Te_i	Total entering running time (s/veh)	355			
16	Rmo	Excess running time moving out of parking stalls (s/veh)	0.0			
17	Tx_i	Total exiting running time (s/veh)	34			
18	Qa	Total emission rate from a parking lot ($g/m^2 - s$)	.00032			
19	Qa'	Area source emission rate without the emissions from internal road segment, i				

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS 1982 1-HOUR NO BUILD
(see instructions following)

Project No.: 2026.01 Analyst: R. Longley

Site: Marketplace Center Date: 6/30/82

Step	Symbol	Inputs/Units	Parcel D-10 Parking Lot			
		Basic Inputs	45°	60°	75°	90°
1		Source ID				
2	SC	Stability class	D	D	D	D
3	U	Wind speed (m s^{-1})	1	1	1	1
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20
6.	x_u	Actual upwind distance (m)	60	56	58	67
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	80	76	78	87
8	x_d	Actual downwind distance (m)	18	13	16	15
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	38	38	36	35
10	Qa	Emission rate (g m^{-2} s^{-1})	.00032	.00032	.00032	.00032
		Dispersion Computation				
11	$(\chi U/Qa)_u$	Upwind normalized concentration	18500	18000	18300	19000
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-16000	-16000	-15000	-15200
13	$\chi U/Qa$	Normalized CO concentration*	2500	2000	3300	3800
14	Qa	Emission rate (g m^{-2} s^{-1})	x.00032	x.00032	x.00032	x.00032
15	χU		0.8	0.6	1.1	1.2
		Enter line 3	÷ 1	÷ 1	÷ 1	÷ 1
16	χ	CO concentration (mg m^{-3})	0.8	0.6	1.1	1.2
17	χ	CO concentration (ppm)	0.7	0.6	0.9	1.1

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS (see instructions following) 1982 1-HOUR NO BUILD

Project No.: 2026.01 Analyst: R. Longley

Site: Marketplace Center Date: 6/30/32

Step	Symbol	Inputs/Units	Parcel D-10 Parking Lot				
		Basic Inputs	105°	120°	135°	150°	165°
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	1	1	1	1	1
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	79	97	110	94	90
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	99	117	130	114	110
8	x_d	Actual downwind distance (m)	15	18	37	37	66
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	35	38	57	57	86
10	Qa	Emission rate (g m^{-2} s^{-1})	.00032	.00032	.00032	.00032	.00032
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	19500	20000	20500	20000	19500
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-15500	-16000	-19000	-19000	-18500
13	$\chi U/Qa$	Normalized CO concentration*	4000	4000	1500	1000	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	x .00032	x .00032	x .00032	x .00032	x .00032
15	χU		1.3	1.3	0.5	0.3	0.3
		Enter line 3	÷ 1	÷ 1	÷ 1	÷ 1	÷ 1
16	χ	CO concentration (mg m^{-3})	1.3	1.3	0.5	0.3	0.3
17	χ	CO concentration (ppm)	1.1	1.1	0.4	0.3	0.3 (0.2)

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

RECEPTOR 2

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS (see instructions following) 1982 1-HOUR NO BUILD

Project No.: 2026.01 Analyst: R. Longley

Site: Marketplace Center Date: 6/30/82

Step	Symbol	Inputs/Units	Parcel D-10 Parking Lot				
		Basic Inputs	210°	225°	240°	255°	270°
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	1	1	1	1	1
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	139	143	146	134	131
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	159	163	166	154	151
8	x_d	Actual downwind distance (m)	107	79	79	81	91
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	137	99	99	101	111
10	Qa	Emission rate (g m^{-2} s^{-1})	.00032	.00032	.00032	.00032	.00032
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	21000	21000	21000	21000	21000
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-20200	-19300	-19300	-19500	-20000
13	$\chi U/Qa$	Normalized CO concentration*	800	1700	1700	1500	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	x .00032	x .00032	x .00032	x .00032	x .00032
15	χU		0.3	0.5	.0.5	0.5	0.3
		Enter line 3	÷ 1	÷ 1	÷ 1	÷ 1	÷ 1
16	χ	CO concentration (mg m^{-3})	0.3	0.5	0.5	0.5	0.3
17	χ	CO concentration (ppm)	0.2	0.5	0.5	0.4	0.3

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

Worksheet 1 1982 8-HOUR NO BUILD

TRAFFIC INFORMATION USED IN THE APPLICATION OF THE EVALUATION PROCEDURE

1.	[illegible]	
2.	[illegible] 1-hr [illegible] (vph)	
	Observed 8-hr volume (vph)	
	Projected 1-hr peak demand (vph)	
	Projected 8-hr peak demand (vph)	
3.	Percentage cold starts	
4.	Percentage trucks and buses	
5.	Metropolitan population	
6.	Slope	
7.	Free-flow parameters	
	Number of lanes	
	Average lane width (ft)	
	Design speed (mph)	
	Highway type (see Figures 2-5)	
8.	Intersection parameters	
	Intersection designation	
	Approach width (ft)	
	Percentage right turns	
	Percentage left turns	
	Type control and description of signal controller	
9.	Area source parameters	
	Parking lot gate designation	1
	Projected 1-hr peak entrance demand (vph)	72
	Projected 1-hr peak exit demand (vph)	73
	Projected 8-hr peak entrance demand (vph)	
	Projected 8-hr peak exit demand (vph)	
	Parking lot area (m^2)	6061
	Parking lot capacity (cars)	179
	Running time required to access auxiliary parking (s)	-
	Facility emptying time	-
	Average cars per stall	-
	Average area per stall (m^2)	1

WORKSHEET 3--AREA SOURCE EMISSIONS COMPUTATION (see instructions following) 1982 8-HOUR NO BUILD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/6/82

Step	Symbol	Input/Units				
1	Brt	Base running time	———	———	———	———
1.1		Base approach time(s)	———			
1.2		Base entrance time(s)	———			
1.3		Base movement-in time(s)	———			
1.4		Base stop, base start time(s)	———			
1.5		Base movement-out time(s)	———			
1.6		Base exit time(s)	———			
1.7		Base departure time(s)	———			
1.8		Total base running time(s)	131			
2	A	Area of parking lot (m^2)	606			
3	i	Entrance approach identification	1	———	———	———
4	Ve_i	Entrance demand volume (vph)	72	———	———	———
5	Ce_i	Entrance approach capacities (vph)	240	———	———	———
6	i	Exit approach identification	1	———	———	———
7	Vx_i	Exit demand volume (vph)	73	———	———	———
8	Cx_i	Exit approach capacities (vph)	180	———	———	———
9		Number of parking spaces occupied	179			
10	F	Emissions	.178	———	———	———
11	Pc	Capacity of parking lot (veh)	179			
12	Pmi	Excess movement-in time(s)	357			
13	Fet	Facility emptying time(s)	3600			
14		Excess running time	—			
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio	.30	———	———	———
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio	.41	———	———	———
14.3	Re_i	Excess running time entering parking lot	6	———	———	———
14.4	Rx_i	Excess running time exiting parking lot	14	———	———	———
15	Te_i	Total entering running time (s/veh)	363	———	———	———
16	Rmo	Excess running time moving out of parking stalls (s/veh)	0.0			
17	Tx_i	Total exiting running time (s/veh)	14	———	———	———
18	Qa	Total emission rate from a parking lot (g/m^2 - s)	.00022			
19	Qa'	Area source emission rate without the emissions from internal road segment, i	———			

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS 1982 8-HOUR NO BUILD
(see instructions following)

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/6/82

Step	Symbol	Inputs/Units	Parcel D-10 Parking Lot			
		Basic Inputs	45°	60°	75°	90°
1		Source ID				
2	SC	Stability class	D	D	D	D
3	U	Wind speed (m s^{-1})	3	3	3	3
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20
6	x_u	Actual upwind distance (m)	60	56	58	67
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	80	76	78	87
8	x_d	Actual downwind distance (m)	18	18	16	15
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	38	38	36	35
10	Qa	Emission rate (g m^{-2} s^{-1})	.00022	.00022	.00022	.00022
		Dispersion Computation				
11	$(\chi U/Qa)_u$	Upwind normalized concentration	18500	18000	18300	19000
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-16000	-16000	-15000	-15200
13	$\chi U/Qa$	Normalized CO concentration*	2500	2000	3300	3800
14	Qa	Emission rate (g m^{-2} s^{-1})	x .00022	x .00022	x .00022	x .00022
15	χU		0.6	0.4	0.7	0.8
		Enter line 3	÷ 3	÷ 3	÷ 3	÷ 3
16	χ	CO concentration (mg m^{-3})	0.2	0.2	0.2	0.3
17	χ	CO concentration (ppm)	0.2	0.1	0.2	0.2

*Use Table 11 to determine $\chi u/Qs$ if r_u > 500 m and skip Steps 11 and 12.

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS 1982 8-HOUR NO BUILD
(see instructions following)

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/6/82

Step	Symbol	Inputs/Units		Parcel D-10 Parking lot			
		Basic Inputs	105°	120°	135°	150°	165°
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	3	3	3	3	3
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	79	97	110	94	90
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	99	117	130	114	110
8	x_d	Actual downwind distance (m)	15	18	37	37	66
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	35	38	57	57	86
10	Qa	Emission rate (g m^{-2} s^{-1})	.00022	.00022	.00022	.00022	.00022
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	19500	20000	20500	20000	19500
12	$(\chi U/Qa)_s$	Downwind normalized concentration	15500	16000	19000	19000	18500
13	$\chi U/Qa$	Normalized CO concentration*	4000	4000	1500	1000	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	.00022	x .00022	x .00022	x .00022	x .00022
15	χU		0.9	0.9	0.3	0.2	0.2
		Enter line 3	3	÷ 3	÷ 3	÷ 3	÷ 3
16	χ	CO concentration (mg m^{-3})	0.3	0.3	0.1	0.1	0.1
17	χ	CO concentration (ppm)	0.2	0.2	0.1	0.1	0.1

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

RECEPTOR 2

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS (see instructions following)

1982 8-HOUR NO BUILD

Project No.: 2026.01

Site: Marketplace Center

Analyst: RL

Date: 7/6/82

Step	Symbol	Inputs/Units		Parcel D-10 Parking Lot			
		Basic Inputs	210°	225°	240°	255°	270°
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	3	3	3	3	3
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	139	143	146	134	131
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	159	163	166	154	151
8	x_d	Actual downwind distance (m)	107	79	79	81	91
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	137	99	99	101	111
10	Qa	Emission rate (g m^{-2} s^{-1})	.00022	.00022	.00022	.00022	.00022
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	21000	21000	21000	21000	<1000
12	$(\chi U/Qa)_s$	Downwind normalized concentration	20200	-19300	-19300	-19500	-20000
13	$\chi U/Qa$	Normalized CO concentration*	800	1700	1700	1500	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	.00022	x .00022	x .00022	x .00022	x .00022
15	χU		0.2	0.4	0.4	0.3	0.2
		Enter line 3	3	÷ 3	÷ 3	÷ 3	÷ 3
16	χ	CO concentration (mg m^{-3})	0.1	0.1	0.1	0.1	0.1
17	χ	CO concentration (ppm)	—	0.1	0.1	0.1	0.1

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

Worksheet 1 1987 1 Hour No Build

TRAFFIC INFORMATION USED IN THE APPLICATION OF THE EVALUATION PROCEDURE

1.	Road segment or intersection approach identification	
2.	Observed 1-hr volume (vph)	
	Observed 8-hr volume (vph)	
	Projected 1-hr peak demand (vph)	
	Projected 8-hr peak demand (vph)	
3.	Percentage cold starts	
4.	Percentage trucks and buses	
5.	Metropolitan population	
6.	Slope	
7.	Freeway parameters	
	Number of lanes	
	Average lane width (ft)	
	Design speed (mph)	
	Highway type (see Figures 2-5)	
8.	Intersection parameters	
	Intersection designation	
	Approach width (ft)	
	Percentage right turns	
	Percentage left turns	
	Type control and description of signal controller	
9.	Area source parameters	
	Parking lot gate designation	1
	Projected 1-hr peak entrance demand (vph)	101
	Projected 1-hr peak exit demand (vph)	114
	Projected 8-hr peak entrance demand (vph)	
	Projected 8-hr peak exit demand (vph)	
	Parking lot area (m^2)	6061
	Parking lot capacity (veh)	179
	Running time required to access auxiliary parking (s)	-
	Facility emptying time	-
	Average cars per stall	-
	Average area per stall (m^2)	1

WORKSHEET 3--AREA SOURCE EMISSIONS COMPUTATION (see instructions following) 1987 1-HOUR NO BUILD

Project No.: 2026.01 Analyst: R. Lixley

Site: Marketplace Center Date: 6/21/92

Step	Symbol	Input/Units				
1	Brt	Base running time	-			
1.1		Base approach time(s)				
1.2		Base entrance time(s)				
1.3		Base movement-in time(s)				
1.4		Base stop, base start time(s)				
1.5		Base movement-out time(s)				
1.6		Base exit time(s)				
1.7		Base departure time(s)				
1.8		Total base running time(s)	131			
2	A	Area of parking lot (m^2)	6061			
3	i	Entrance approach identification	1			
4	Ve_i	Entrance demand volume (vph)	101			
5	Ce_i	Entrance approach capacities (vph)	240			
6	i	Exit approach identification	1			
7	Vx_i	Exit demand volume (vph)	114			
8	Cx_i	Exit approach capacities (vph)	120			
9		Number of parking spaces occupied	179			
10	F	Emissions	.116			
11	Pc	Capacity of parking lot (veh)	179			
12	Rmi	Excess movement-in time(s)	345			
13	Fet	Facility emptying time(s)	3600			
14		Excess running time	-			
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio	.42			
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio	.63			
14.3	Re_i	Excess running time entering parking lot	10			
14.4	Rx_i	Excess running time exiting parking lot	34			
15	Te_i	Total entering running time (s/veh)	355			
16	Rmo	Excess running time moving out of parking stalls (s/veh)	0.0			
17	Tx_i	Total exiting running time (s/veh)	34			
18	Qa	Total emission rate from a parking lot (g/m^2 - s)	.00021			
19	Qa'	Area source emission rate without the emissions from internal road segment, i				

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS 1987 1-HOUR NO BUILD
(see instructions following)

Project No.: 2026.01 Analyst: R. Longley

Site: Marketplace Center Date: 6/30/82

Step	Symbol	Inputs/Units	Parcel D-10 Parking Lot			
		Basic Inputs	45°	60°	75°	90°
1		Source ID				
2	SC	Stability class	D	D	D	D
3	U	Wind speed (m s^{-1})	1	1	1	1
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20
6	x_u	Actual upwind distance (m)	60	56	58	67
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	80	76	78	87
8	x_d	Actual downwind distance (m)	18	18	16	15
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	38	38	36	35
10	Qa	Emission rate (g m^{-2} s^{-1})	.00021	.00021	.00021	.00021
		Dispersion Computation				
11	$(\chi U/Qa)_u$	Upwind normalized concentration	18500	18000	18300	19000
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-16000	-16000	-15000	-15200
13	$\chi U/Qa$	Normalized CO concentration*	2500	2000	3300	3800
14	Qa	Emission rate (g m^{-2} s^{-1})	x.00021	x.00021	x.00021	x.00021
15	χU		0.5	0.4	0.7	0.8
		Enter line 3	÷ 1	÷ 1	÷ 1	÷ 1
16	χ	CO concentration (mg m^{-3})	0.5	0.4	0.7	0.8
17	χ	CO concentration (ppm)	0.4	0.4	0.6	0.7

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS (see instructions following) 1997 1-HOUR NO BUILD

Project No.: 2026.01 Analyst: K. Longley

Site: Marketplace Center Date: 6/30/92

Step	Symbol	Inputs/Units	Parcel D-10 Parking Lot				
		Basic Inputs	105°	120°	135°	150°	165°
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	1	1	1	1	1
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	79	97	110	94	90
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	99	117	130	114	110
8	x_d	Actual downwind distance (m)	15	18	37	37	66
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	35	38	57	57	86
10	Qa	Emission rate (g m^{-2} s^{-1})	.00021	.00021	.00021	.00021	.00021
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	19500	20000	20500	20000	19500
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-15500	-16000	-19000	-19000	-18500
13	$\chi U/Qa$	Normalized CO concentration*	4000	4000	1500	1000	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	x .00021	x .00021	x .00021	x .00021	x .00021
15	χU		0.8	0.8	0.3	0.2	0.2
		Enter line 3	÷ 1	÷ 1	÷ 1	÷ 1	÷ 1
16	χ	CO concentration (mg m^{-3})	0.8	0.8	0.3	0.2	0.2
17	χ	CO concentration (ppm)	0.7	0.7	0.3	0.2	0.2

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

RECEPTOR 2

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS (see instructions following) 1987 1-HOUR NO BUILD

Project No.: 2026.01 Analyst: R. Longley

Site: Marketplace Center Date: 6/30/82

Step	Symbol	Inputs/Units	Parcel D-10 Parking Lot				
		Basic Inputs	210°	225°	240°	255°	270°
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	1	1	1	1	1
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	139	143	146	134	131
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	159	163	166	154	151
8	x_d	Actual downwind distance (m)	107	79	79	81	91
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	137	99	99	101	111
10	Qa	Emission rate (g m^{-2} s^{-1})	.00021	.00021	.00021	.00021	.00021
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	21000	21000	21000	21000	21000
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-20200	-19300	-19300	-19500	-20000
13	$\chi U/Qa$	Normalized CO concentration*	800	1700	1700	1500	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	x .00021	x .00021	x .00021	x .00021	x .00021
15	χU		0.27	0.4	0.4	0.3	0.2
		Enter line 3	÷ 1	÷ 1	÷ 1	÷ 1	÷ 1
16	χ	CO concentration (mg m^{-3})	0.27	0.4	0.4	0.3	0.2
17	χ	CO concentration (ppm)	0.2	0.3	0.3	0.3	0.2

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

1987 8-HOUR NO BUILD

Worksheet 1

TRAFFIC INFORMATION USED IN THE APPLICATION OF THE EVALUATION PROCEDURE

1.	[illegible]	
2.	[illegible] 1-hr vol [illegible] (vph)	
	Observed 8-hr volume (vph)	
	Projected 1-hr peak demand (vph)	
	Projected 8-hr peak demand (vph)	
3.	Percentage cold starts	
4.	Percentage trucks and buses	
5.	Metropolitan population	
6.	Slope	
7.	Free-flow parameters	
	Number of lanes	
	Average lane width (ft)	
	Design speed (mph)	
	Highway type (see Figures 2-5)	
8.	Intersection parameters	
	Intersection designation	
	Approach width (ft)	
	Percentage right turns	
	Percentage left turns	
	Type control and description of signal controller	
9.	Area source parameters	
	Parking lot gate designation	1
	Projected 1-hr peak entrance demand (vph)	73
	Projected 1-hr peak exit demand (vph)	72
	Projected 8-hr peak entrance demand (vph)	
	Projected 8-hr peak exit demand (vph)	
	Parking lot area (m^2)	6061
	Parking lot capacity (cars)	179
	Running time required to access auxiliary parking (s)	
	Facility emptying time	
	Average cars per stall	
	Average area per stall (m^2)	

WORKSHEET 3--AREA SOURCE EMISSIONS COMPUTATION (see instructions following) 1987 8-HOUR NO BUILD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/7/82

Step	Symbol	Input/Units				
1	Brt	Base running time	____	____	____	____
1.1		Base approach time(s)	____			
1.2		Base entrance time(s)	____			
1.3		Base movement-in time(s)	____			
1.4		Base stop, base start time(s)	____			
1.5		Base movement-out time(s)	____			
1.6		Base exit time(s)	____			
1.7		Base departure time(s)	____			
1.8		Total base running time(s)	131			
2	A	Area of parking lot (m^2)	6061			
3	i	Entrance approach identification	1	____	____	____
4	Ve_i	Entrance demand volume (vph)	73	____	____	____
5	Ce_i	Entrance approach capacities (vph)	240	____	____	____
6	i	Exit approach identification	1	____	____	____
7	Vx_i	Exit demand volume (vph)	72	____	____	____
8	Cx_i	Exit approach capacities (vph)	180	____	____	____
9		Number of parking spaces occupied	179			
10	F	Emissions	.1116	____	____	____
11	Pc	Capacity of parking lot (veh)	179			
12	Rmi	Excess movement-in time(s)	357			
13	Fet	Facility emptying time(s)	3600			
14		Excess running time	-			
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio	.3	____	____	____
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio	.41	____	____	____
14.3	Re_i	Excess running time entering parking lot	6	____	____	____
14.4	Rx_i	Excess running time exiting parking lot	17	____	____	____
15	Te_i	Total entering running time (s/veh)	363	____	____	____
16	Rmo	Excess running time moving out of parking stalls (s/veh)	0.0			
17	Tx_i	Total exiting running time (s/veh)	14	____	____	____
18	Qa	Total emission rate from a parking lot (g/m^2 - s)	.0002			
19	Qa'	Area source emission rate without the emissions from internal road segment, i	____			

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS (see instructions following) 1987 8-HOUR NO BUILD

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/7/82

Step	Symbol	Inputs/Units				
		Basic Inputs	45°	60°	75°	90°
1		Source ID				
2	SC	Stability class	D	D	D	D
3	U	Wind speed (m s^{-1})	3	3	3	3
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20
6	x_u	Actual upwind distance (m)	60	56	58	67
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	80	76	78	87
8	x_d	Actual downwind distance (m)	18	18	16	15
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	38	38	36	35
10	Qa	Emission rate (g m^{-2} s^{-1})	.0002	.0002	.0002	.0002
		Dispersion Computation				
11	$(\chi U/Qa)_u$	Upwind normalized concentration	18506	16000	18300	19006
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-16000	-16000	-15000	-15226
13	$\chi U/Qa$	Normalized CO concentration*	~~2500~~	2000	3300	3800
14	Qa	Emission rate (g m^{-2} s^{-1})	x .0002	x .0002	x .0002	x .0002
15	χU		.5	.4	.7	.8
		Enter line 3	÷ 3	÷ 3	÷ 3	÷ 3
16	χ	CO concentration (mg m^{-3})	.2	.1	.2	.2
17	χ	CO concentration (ppm)	.2	.1	.2	.2

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

RECEPTOR 1

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS 1987 8-HOUR NO BUILD
(see instructions following)

Project No.: 2026.01 Analyst: RI

Site: Marketplace Center Date: 7/7/82

Step	Symbol	Inputs/Units					
		Basic Inputs	105	120	135°	150°	165°
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	3	3	3	3	3
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	79	97	110	94	90
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	99	117	130	114	110
8	x_d	Actual downwind distance (m)	15	18	37	37	66
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	35	38	57	57	86
10	Qa	Emission rate (g m^{-2} s^{-1})	.0002	.0002	.0002	.0002	.0002
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	19500	20000	20500	20000	19500
12	$(\chi U/Qa)_s$	Downwind normalized concentration	15500	-16000	-19000	-19000	-18500
13	$\chi U/Qa$	Normalized CO concentration*	4000	4000	1500	1000	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	.0002	x .0002	x .0002	x .0002	x .0002
15	χU		.8	.8	.3	.2	
		Enter line 3	.3	÷ 3	÷ 3	÷ 3	÷ 3
16	χ	CO concentration (mg m^{-3})	.3	.3	.1	.07	
17	χ	CO concentration (ppm)	0.2	0.3	0.1	.06	—

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

RECEPTOR 2

WORKSHEET 6--CO AREA SOURCE DISPERSION ANALYSIS 1987 8-HOUR NO BUILD
(see instructions following)

Project No.: 2026.01 Analyst: RL

Site: Marketplace Center Date: 7/7/87

Step	Symbol	Inputs/Units					
		Basic Inputs	210	225	240	255	270
1		Source ID					
2	SC	Stability class	D	D	D	D	D
3	U	Wind speed (m s^{-1})	3	3	3	3	3
4	σ_{z_o}	Initial dispersion (m)	5	5	5	5	5
5	x_o	Virtual dispersion distance (m)	20	20	20	20	20
6	x_u	Actual upwind distance (m)	139	143	146	134	131
7	$r_u = x_u + x_o$	Effective upwind distance* (m)	159	163	166	154	151
8	x_d	Actual downwind distance (m)	107	79	79	81	91
9	$r_d = x_d + x_o$	Effective downwind distance* (m)	137	99	99	101	111
10	Qa	Emission rate (g m^{-2} s^{-1})	.0002	.0002	.0002	.0002	.0002
		Dispersion Computation					
11	$(\chi U/Qa)_u$	Upwind normalized concentration	21000	21000	21000	21000	21000
12	$(\chi U/Qa)_s$	Downwind normalized concentration	-02000	-19300	-19300	-19500	-20000
13	$\chi U/Qa$	Normalized CO concentration*	800	1700	1700	1500	1000
14	Qa	Emission rate (g m^{-2} s^{-1})	.0002	x .0002	x .0002	x .0002	x .0002
15	χU		.2	.3	.3	.3	.2
		Enter line 3	3	÷ 3	÷ 3	÷ 3	÷ 3
16	χ	CO concentration (mg m^{-3})	.05	.1	.1	.1	.07
17	χ	CO concentration (ppm)	—	0.1	0.1	0.1	0.1

*Use Table 11 to determine $\chi u/Qs$ if r > 500 m and skip Steps 11 and 12.

Emission Rate (Q) for parking Garage

$Q = FTV/3600$ (gm/s)

where F = idling emissions rate (g/s) = 6.9 gm/min /60 = .116 g/s

T = the average running time in the garage for a vehicle to enter and park or unpark and exit (s)

*for the parking lot it takes 70 seconds to exit, 20 seconds for attendant to calculate cost and make change. For this analysis, assume exiting time without attendant

70 - 20 = (50s)

V = the total number of cars entering and exiting during the hour = (88) vehicles/hour

$Q = (.116)(50)(88)/3600 = 0.14$ g/s

Brigg's Equation for Momentum plume rise unstable and neutral conditions (Pasquil - Giffard Classes A-D)

$$\Delta h_m = \left[\frac{3 F_M X'}{\beta_j^2 u_h^2}\right]^{1/3}$$

where F_M = momentum flux term

$$= (T_a/T_s) V_s^2 d^2/4$$

T_a = ambient air temperature (°K)

20°C = 293.16 °K

T_s = stack exit temperature (°K)

assume unheated garage

25°C = 298.16 °K

V_s = stack exit velocity (m/s)
∴ 2 fans at 30,000 cfm

$30{,}000 \times .02832 = 849.6\ m^3/min / 60 =$

$14.2\ m^3/sec$

area of one opening = $5.5\ m^2$

$$\frac{14.2\ m^3/sec}{5.5\ m^2} = 2.58\ m/sec$$

(one opening)

d = stack inner diameter (m) (2.6)

$(T_a/T_s)\ V_s^2 d^2/4 =$

$(293.16/298.16)(2.58)^2(2.6)^2/4 = 11.1$

Solve for x'

x' = the smallest value of x or the expression

$4d(V_s + 3u_h)^2 / V_s u_h$

$4(2.6)[2.58 + 3(1)]^2 / (2.58)(1) = 126\ m$

Solve for B_j

B_j = jet entrainment coefficient

$= (1/3 + u_h / V_s)$

$= (1/3 + 1/2.58)$

$= .72$

SASAKI ASSOCIATES, INC.
64 PLEASANT STREET
WATERTOWN, MA 02172

$$\Delta h_m = \left[\frac{3\,(11.1)\,(126)}{(.72)^2\,(1)^2}\right]^{1/3}$$

$$\Delta h_m = \left[\frac{4196}{.52}\right]^{1/3}$$

$$\Delta h_m = [8069]^{1/3}$$

approx. 20

H = effective height of ventilation system exhaust

$= h + \Delta h$

h = actual height of exhaust duct

h = 6 m

$= 6 + 20 = 26$ m for one opening

Gaussian Virtual Point Source Equation

$$\chi(x,o,z,H) = \frac{870Q}{2\sigma_y\sigma_z u}\left[\exp -\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2 + \exp -\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]$$

where:

χ = the CO concentration at receptor coordinates (x, o,z) (ppm)

870 = conversion factor from g/m^3 to ppm for CO

Q = emission rate (g/s) 0.14

u = wind speed (m/s) 1

$\sigma_y\sigma_z$ = Pasquill-Gifford dispersion rates determined as a function of stability class and x (m) 61

z = height of the receptor above ground level (m) 1.5

H = effective height of the ventilation system exhaust 26

= h + Δh

h = actual height of exhaust duct (m)

Δh = momentum plume rise of exhaust due to exit velocity (m)

x = the distance at which σ_{z_o} = 5 m, the initial vertical mixing for urban surface roughness .11

x' = actual distance of the receptor from the center of the exhaust duct (m) Ref pt 70m 8-Receptor 85

x_y = the distance at which σ_y = s/4.3

x_z = the distance at which σ_z = d/4.3

s = the crosswind length of the exhaust duct opening (m) 4

d = the vertical distance of the opening in the garage facing the receptor (m)

σ_y = 8 m

σ_x = 7.6 m

PROJECT NO ___ SASAKI ASSOCIATES, INC. 64 PLEASANT STREET WATERTOWN, MA 02172 DATE ___
TITLE ___ BY ___ CK'D ___

1 — HOUR

For Receptor 1 w/ 90° wind or 62° from North
and Receptor 2 w/ 90° wind or 240° from North

$$\chi = \frac{870(.14)}{2(8)(7.6)(1)}\left[\exp\left(-\tfrac{1}{2}\left(\frac{1.5-26}{7.6}\right)^2\right) + \exp\left(-\tfrac{1}{2}\left(\frac{1.5+26}{7.6}\right)^2\right)\right]$$

$$\chi = \frac{122}{122}\left[\exp\left(-\tfrac{1}{2}(-3.22)^2\right) + \exp\left(-\tfrac{1}{2}(3.62)^2\right)\right]$$

$$\chi = \frac{122}{122}\left[\exp(-5.18) + \exp(-6.55)\right]$$

$$\chi = 1\,[.006 + .001]$$

$$\chi = 1\,[.007]$$

$$\chi = .007 \times 2 \text{ stacks} = .014$$

8-HOUR

$$Q = .116 \text{ g/s} \times 505 \times 95 \text{ vehicles/hour} \,/\, 3600 = 0.15 \text{ g/s}$$

Solve for x'

$$= 4d\,(V_s + 3_{u_h})^2 / V_s\, u_h$$

$$4(2.4)\left[2.58 + 3(3)\right]^2 / 2.58\,(3) = 181 \text{ meters}$$

Solve for D $= \left(\frac{1}{3} + u_h / V_s\right)$

$$= \left(\tfrac{1}{3} + 3/2.58\right)$$

$$= 1.5$$

$$\Delta h_m = \left[\frac{3(71.1)(181)}{1.5^2 (3)^2} \right]^{1/3}$$

$$\Delta h_m = [301]^{1/3}$$

about 7

$$H = h + \Delta h$$

$$6 + 7 = 13 \text{ m}$$

$$\chi = \frac{870(.15)}{2(8)(7.6)(3)} \left[\exp\left(-\tfrac{1}{2}\left(\frac{1.5-13}{7.6}\right)^2\right) + \exp\left(-\tfrac{1}{2}\left(\frac{1.5+13}{7.6}\right)^2\right) \right]$$

$$= \frac{130}{365} \left[(.32 + .16) \right]$$

$$= .37 \, [.48] = .18 \times 2 \text{ openings} = .36$$

A P P E N D I X III

SUBSURFACE BORING LOGS

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 3

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-101 A

LINE & STA.

OFFSET

SURF. ELEV. 15.6

GROUND WATER OBSERVATIONS

At 10' 3/26/82 after — Hours

At 15.0' 3/29/82 after — Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR.
Type	HW	S/S	NXD3
Size I D	4"	1 3/8"	
Hammer Wt	Drilled	140#	BIT
Hammer Fall		30"	Dia.

	Date	Time
START	3/25/82	a.m. p.m.
COMPLETE	3/29/82	a.m. p.m.
TOTAL HRS.		
BORING FOREMAN	G.Brouillette	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
									Brown fine to medium Sand & Gravel - FILL			
		5'-6'6"	D	30	31	39	Dry very dense		Boulders, Old Cement & Granite Blocks	1	18"	16"
									@ 9' - Brick			
								10'				
		10'-11'6"	D	5	2	10	Wet medium dense		Black fine to medium Sand & Organic Silt, some wood, trace of brick - FILL	2	18"	16"
								13'				
		14'-15'6"	D	46	9	23	Wet dense		Brown Wood - FILL	3	18"	11"
								18'				
		19'-20'6"	D	5	6	11	Wet very stiff		Yellow Brown Silty CLAY	4	18"	18"
		24'-26'	UP							-	24"	0"
		27'-28'6"	D	3	3	4	Wet medium stiff		Brown CLAY, trace of fine sand layers	5	18"	18"
		29'-31'	UP							U1	24"	18"
								31'				
		31'-32'6"	D	3	4	5	Wet stiff		" color change to Gray	6	18"	18"
		34'-35'6"	D	4	4	4				7	18"	18"
		39'-40'6"	D	3	4	5				8	18"	18"

GROUND SURFACE TO 24' USED HW "CASING: THEN

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
		15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 99'
Rock Coring 10'
Samples 17

HOLE NO B-101A

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 3

TO _____ ADDRESS _____

PROJECT NAME _____ LOCATION _____

REPORT SENT TO _____ PROJ. NO. _____

SAMPLES SENT TO _____ OUR JOB NO. 82-263

DATE _____

HOLE NO. B-101 A

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec.
		44'-45'6"	D	4	5	5	Wet stiff		Gray CLAY	9	18"	18"
		49'-50'6"	D	3	5	6	"		" trace of sand in layers	10	18"	18"
		54'-56'	UP							U2	24"	20"
		59'-60'6"	D	3	4	5	"			11	18"	18"
								63'				
		64'-65'6"	D	10	12	25	Wet Hard		Gray CLAY, some fine sand	12	18"	18"
		69'-71'	UP						very sandy	-	24"	4"
								72'				
									Boulder			
		74'-75'6"	D	7	7	9	Wet very stiff		Gray clayey SAND, trace of fine gravel	13	18"	2"
								79'				
		79'-80'6"	D	4	5	5	W/stiff		Gray CLAY, trace fine sand	14	18"	18"

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring _____
Rock Coring _____
Samples _____

HOLE NO B-101A

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R. I.

SHEET 3 OF 3
DATE
HOLE NO. B-101 A
LINE & STA.
OFFSET
SURF. ELEV.

TO
ADDRESS
PROJECT NAME
LOCATION
REPORT SENT TO
PROJ. NO.
SAMPLES SENT TO
OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
		84'-85'6"	D	5	8	8	Wet very stiff	87'	Gray CLAY	15	18"	12"
		89'-90'6"	D	29	34	50	Wet. very dense	92'	Gray silty fine to medium SAND & fine Gravel, lit. clay Argillite Fragments	16	18"	12"
		94'-95'6"	D	30	30	40	Moist very dense	99'	Gray weathered ARGILLITE	17	18"	18"
		99'-104'	C				Min/ft 4 4 5 5 6			C	60"	39"
		104'-109'	C				5 5 5 5 6	109'		C	60"	48"
									Bottom of Boring 109'			
									Installed Observation Well at 20'			
									10' of Slotted PVC			
									10' of Solid PVC			
									1 Bag of Ottowa Sand			
									1 Bag of Cement			
									1 Road Box			

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring
Rock Coring
Samples

HOLE NO. B-101A

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 3

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-102

LINE & STA.

OFFSET

SURF. ELEV. 15.3

GROUND WATER OBSERVATIONS

At 13'8" after ___ Hours
no casing

At ___ after ___ Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR
Type	HW	S/S	
Size I D	4"	1 3/8"	
Hammer Wt	300/440#	140#	BIT
Hammer Fall	24"	30"	

	Date	Time
START	3/30/82	a.m. p.m.
COMPLETE	4/1/82	a.m. p.m.
TOTAL HRS.		
BORING FOREMAN	J. Texeira	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
	60											
	70	1'-2'6"	D	12	18	19	Moist dense			1	18"	16"
	120											
	130	Drill							Brown gray coarse to fine gravely SAND & Rubble FILL			
	139											
	70	5'-6'6"	D	38	69	75	Dry very dense			2	18"	10"
	85											
	135	Drill										-
	160											
	191											
	180											
	270											
		Drill										
	D											
	r											
	i											
	l											
	l											
								19'				
	18	20'-21'6"	D	7	9	20	Moist very stiff		Yellow CLAY (trace of gravel)	3	18"	18"
	12											
	26											
	28											
		24'-25'6"	D	9	9	14	"			4	18"	18"
		29'-30'6"	D	5	5	9	Moist stiff			5	18"	18"
								33'9"				
		34'-35'6"	D	3	4	5	Wet stiff		Blue CLAY	6	18"	18"
		39'-40'6"	D	4	6	9	"			7	18"	18"

GROUND SURFACE TO ___ USED ___ "CASING: THEN ___

Sample Type
D: Dry C: Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test
UT Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring 85'
Rock Coring
Samples 16

HOLE NO. B-102

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R. I.

SHEET 2 OF 3

TO _____ ADDRESS _____

PROJECT NAME _____ LOCATION _____

REPORT SENT TO _____ PROJ. NO. _____

SAMPLES SENT TO _____ OUR JOB NO. 82-263

DATE _____

HOLE NO. B-102

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		
BORING FOREMAN		
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
									Blue CLAY			
		44'-45'6"	D	3	3	5	Wet stiff			8	18"	18"
								48'3"				
		49'-50'6"	D	8	6	9	"		Blue CLAY, trace of fine sand	9	18"	18"
								54'				
		54'-55'6"	D	7	8	10	Wet very stiff		Blue CLAY	10	18"	18"
		59'-60'6"	D	7	7	9	"			11	18"	18"
		64'-65'6"	D	4	5	8	Wet stiff			12	18"	18"
								69'				
		69'-70'6"	D	5	5	11	Wet very stiff		Blue CLAY, trace of fine sand	13	18"	18"
		74'-75'6"	D	8	9	14	"			14	18"	18"

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring _____
Rock Coring _____
Samples _____

HOLE NO B-102

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 3 OF 3
DATE
HOLE NO. B-102
LINE & STA.
OFFSET
SURF. ELEV.

TO
PROJECT NAME
REPORT SENT TO
SAMPLES SENT TO
ADDRESS
LOCATION
PROJ. NO.
OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
		79'-80'6"	D	8	9	14	Wet/v stiff		Blue CLAY	15	18"	18"
							Moist					
		84'-85'	D	6	6		stiff	85'		16	12"	12"
		@ 85'	D	150/0"					Refusal at 85'			
				110/0" (300#)								

GROUND SURFACE TO _____ USED _____ "CASING. THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140lb Wt. x 30" fall on 2" O.D. Sampler

Conesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring _____
Rock Coring _____
Samples _____

HOLE NO B-102

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 1

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-103 OW -

LINE & STA.

OFFSET

SURF. ELEV. 15.6

GROUND WATER OBSERVATIONS

At _____ after ____ Hours

At _____ after ____ Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR
Type	HW	S/S	
Size I D	4"	1 3/8"	
Hammer Wt	Drilled	140#	BIT
Hammer Fall		30"	

	Date	Time
START	3/24/82	a.m. p.m.
COMPLETE	3/24/82	a.m. p.m.
TOTAL HRS.		

BORING FOREMAN J. Texeira

INSPECTOR

SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								6"	Black Top			
		6"-2'	D	23	46	68	Dry very dense		Black Cinders & Red Brick FILL	1	18"	-
		5'-6'6"	D	22	75	28	Wet very dense		Brown Sand, Silt, Gravel, Ash & Brick - FILL (lost Button Bit in hole (Drilled hole to 14')	2	18"	-
								14'	Bottom of Boring 14'			

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A-Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	
50 +	Very Dense	15-30	V. Stiff	

SUMMARY:
Earth Boring 14'
Rock Coring
Samples 2

HOLE NO B103OW

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 3

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-103 OW A

LINE & STA.

OFFSET

SURF. ELEV. 15.6

GROUND WATER OBSERVATIONS

At ____ after ____ Hours

At ____ after ____ Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR.
Type	HW	S/S	
Size I D	4"	1 3/8"	
Hammer Wt	Drill	140#	BIT
Hammer Fall		30"	

	Date	Time
START	3/24/82	a.m. p.m.
COMPLETE	3/26/82	a.m. p.m.

TOTAL HRS.

BORING FOREMAN J. Texeira

INSPECTOR

SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								6"	Black Top			
									FILL			
								7'				
		9'-10'6"	D	1	1	1	Wet soft		Gray Organic SILT, trace of shells	1	18"	18"
		14'-15'6"	D	1	1	1	"			2	18"	18"
		19'6"-21'	D	7	5	6	Wet stiff			3	18"	18"
								24'				
		24'-25'	D	3	2		Moist medium stiff	25'	Dark Brown PEAT	4	12"	12"
		25'-26'	D	3	5				Blue CLAY	4A	12"	12"
								27'				
		27'-29'	UP							-	24"	0"
									Blue & Yellow CLAY has very coarse Gravel			
		30'-32'	UP						(30' - 32'-- 5" recovery in jar)	-	24"	0"
		33'-34'6"	D	7	9	13	Wet very stiff		Yellow CLAY	5	18"	18"
		38'-39'6"	D	5	10	16	"		" trace of fine sand	6	18"	18"

GROUND SURFACE TO ____ USED ____ "CASING. THEN ____

Sample Type
D: Dry C: Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A-Auger V: Vane Test
UT Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 94'6"
Rock Coring 10'
Samples 15

HOLE NO B-103OW

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 3

TO _____ | ADDRESS _____

PROJECT NAME _____ | LOCATION _____

REPORT SENT TO _____ | PROJ. NO. _____

SAMPLES SENT TO _____ | OUR JOB NO. 82-263

DATE _____

HOLE NO. B-103 OW A

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

at _____ after _____ Hours

at _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I D			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec.
								41'	Yellow CLAY			
		42'-43'6"	D	3	3	6	Wet stiff			7	18"	18"
		44'-46'	UP							U1	24"	14"
		49'-50'6"	D	4	4	5	"		Blue CLAY, trace of fine sand	8	18"	18"
							"	54'6"				
		54'-54'6"	D	10						9	6"	6"
		54'6"-55'6"			15	16	Wet Hard		Gray SILT & fine Sand, trace of clay	9A	12"	12"
		59'-61'	UP							U2	24"	17"
								63'				
		64'-65'6"	D	4	4	6	Wet stiff		Blue CLAY, trace of fine sand layers	10	18"	18"
								68'				
		69'-70'6"	D	11	15	17	Wet Hard		Gray fine sandy SILT, little clay, fine sand layers	11	18"	18"
								73'				
		74'-76'	UP						Blue CLAY, tr. fine sand layers	U3	24"	16"
		79'-80'6"	D	6	5	10	Wet stiff			12	18"	18"

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	
50 +	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring _____
Rock Coring _____
Samples _____

HOLE NO. B103OWA

TOWN PRESS - EAST PROV.

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 3 OF 3

TO _____ ADDRESS _____

PROJECT NAME _____ LOCATION _____

REPORT SENT TO _____ PROJ. NO. _____

SAMPLES SENT TO _____ OUR JOB NO. 82-263

DATE _____

HOLE NO. B-103 OW A

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		
BORING FOREMAN		
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								83'3"				
		84'-85'6"	D	24	32	47	Moist very dense		Gray coarse to fine sandy SILT, little gravel, little clay	13	18"	18"
								89'6"				
		89'-90'6"	D	27	117	80	Dry very dense			14	18"	18"
									Gray weathered ARGILLITE			
		94'-94'6"	D	165	(135/0" -		Ref.)	94'6"		15	6"	-
		94'6"-99'6"	C		Min/Ft		4 4 5 5 4 5 5 5 5 5			C1	60"	22"
		99'6"-104'6"	C							C2	60"	30"
								104'6"				
									Bottom of Boring 104'6"			
									Installed PVC Well at 15'. 2 Bags of Ottowa Sand 1 - 2" Roadway Box			

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type

D=Dry C=Cored W=Washed

UP=Undisturbed Piston

TP=Test Pit A=Auger V=Vane Test

UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY

Earth Boring _____

Rock Coring _____

Samples _____

HOLE NO B103OW

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 3

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-104

LINE & STA.

OFFSET

SURF. ELEV. 16.3

GROUND WATER OBSERVATIONS

At 13'3" after ___ Hours

At ___ after ___ Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR
Type	HW	S/S	NXD3
Size I D	4"	1 3/8"	
Hammer Wt	300#	140#	BIT
Hammer Fall	24"	30"	Dia.

	Date	Time
START	3/29/82	a.m. p.m.
COMPLETE	3/30/82	a.m. p.m.

TOTAL HRS.

BORING FOREMAN J. Texeira

INSPECTOR

SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
	20								Black Top			
	23											
	31	2'-3'6"	D	9	6	11	Dry medium dense		Brown Sand, Gravel & Brick FILL	1	18"	12"
	38											
	14											
		5'-6'6"	D	5	1	1	Wet loose		" & Wood	2	18"	9"
	D											
	r											
	i											
	l							9'3"				
	l	10'-11'6"	D	1	1	1	Wet soft		Brown Gray Organic SILT, trace of fibers	3	18"	9"
	e											
	d											
		14'-15'6"	D	1	1	2	"		" color change to Gray, trace of shells	4	18"	9"
		19'-20'	D	1	2		"	20'		5	12"	12"
		20'-21'6"	D			7	Moist/m stiff		Yellow Blue CLAY	5A	6"	6"
		24'-25'6"	D	9	8	12	Moist very stiff			6	18"	18"
		29'-30'6"	D	6	8	12	"			7	18"	18"
								34'				
		34'-35'6"	D	5	5	6	Wet stiff		Blue CLAY with fine Sand Layers	8	18"	18"
		39'-40'6"	D	4	5	6	"			9	18"	18"

GROUND SURFACE TO 15' USED HW "CASING: THEN Wash to Rock then Install NW Casi

Sample Type
D: Dry C-Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test
UT: Undisturbed Thin wall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
		30 +	Hard

SUMMARY

Earth Boring	99'9
Rock Coring	5'
Samples	21

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE. R I.

SHEET 2 OF 3

TO _____ ADDRESS _____

PROJECT NAME _____ LOCATION _____

REPORT SENT TO _____ PROJ. NO. _____

SAMPLES SENT TO _____ OUR JOB NO. 82-263

DATE _____

HOLE NO. B-104

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
							Wet		Blue CLAY, trace of fine sand			
		44'-45'6"	D	4	6	8	stiff			10	18"	18"
		49'-50'6"	D	4	7	7	"			11	18"	18"
		54'-55'6"	D	4	4	7	"			12	18"	18"
								59'				
		59'-60'6"	D	7	18	20	Wet Hard		Gray fine sandy SILT, trace of Blue Clay	13	18"	18"
		64'-65'6"	D	14	21	13	"			14	18"	18"
								68'6"				
		69'-70'6"	D	6	8	10	Wet very stiff		Blue CLAY	15	18"	18"
								73'				
		74'-75'6"	D	9	16	17	Wet Hard		Blue fine sandy CLAY	16	18"	18"
								79'6"				

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type

D=Dry C=Cored W=Washed

UP=Undisturbed Piston

TP=Test Pit A=Auger V=Vane Test

UT=Undisturbed Thinwall

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:

Earth Boring _____

Rock Coring _____

Samples _____

HOLE NO B-104

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 3 OF 3

TO _____ ADDRESS _____

PROJECT NAME _____ LOCATION _____

REPORT SENT TO _____ PROJ. NO. _____

SAMPLES SENT TO _____ OUR JOB NO. 82-263

DATE _____

HOLE NO. B-104

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec.
		79'-80'6"	D	14	29	53	Wet very dense	83'8"	Gray fine SAND & Silt, trace of clay	17	18"	18"
		84'-85'6"	D	7	6	28	Wet Hard	87'	Blue Silty CLAY, trace of fine sand	18	18"	18"
									Gray coarse to fine sandy SILT, tr. gravel & clay			
		89'-90'6"	D	32	35	58	Moist very dense			19	18"	14"
		94'-95'	D	22	32		"	95'	Top of Rock	20	12"	12"
		95'-95'6"	D			61	Dry very dense		Weathered ARGILLITE	20A	6"	6"
		99'6"-99'9"	D	220/3"			Min/Ft	99'9"		21	3"	3"
		99'9" - 104'9"	C				5			C1	60"	46"
							6					
							6					
							7					
							5	104'9"				
									Bottom of Boring 104'9"			

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type

D=Dry C=Cored W=Washed

UP=Undisturbed Piston

TP=Test Pit A=Auger V=Vane Test

UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY

Earth Boring _____

Rock Coring _____

Samples _____

HOLE NO B-104

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 3

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-105

LINE & STA.

OFFSET

SURF. ELEV. 16.7

GROUND WATER OBSERVATIONS

At 10' after ___ Hours

80' Casing

At ___ after ___ Hours

	Rods-"NW"	CASING	SAMPLER	CORE BAR. NXD3
Type		HW-NW	S/S	Split
Size I D		4" 3"	1 3/8"	
Hammer Wt		300#/Drill	140#	BIT
Hammer Fall		24"	30"	Dia.

	Date	Time
START	4/2/82	a.m p.m
COMPLETE	4/5/82	a.m p.m
TOTAL HRS.		

BORING FOREMAN G.Brouillette

INSPECTOR

SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
									Black Top			
		6"-2'	D	21	49	56	Dry/v dense		Brown fine to medium Sand & fine to coarse Gravel-FILL	1	18"	9"
									(3' to 4' - Wood)			
		4'-5'6"	D	11	12	10	Wet medium dense		Brown silty fine to medium Sand & Gravel - FILL	2	18"	12"
									(Brick in Fill)			
		9'-10'6"	D	8	7	8	"		" color change to Gray FILL	3	18"	9"
		14'-15'6"	D	4	5	8	"	16'		4	18"	9"
								18'	Wood			
		19'-20'6"	D	8	6	8	Wet stiff		Black to Gray Organic silt & Wood (trace of Fill)	5	18"	12"
								24'				
		24'-25'6"	D	10	13	15	Wet very stiff		Gray Yellow silty CLAY	6	18"	16"
		29'-30'6"	D	10	8	10	"		" trace of fine to medium sand & Gravel	7	18"	18"
									Boulder			
								34'				
		34'-35'6"	D	3	4	8	Wet stiff		" color change to Gray	8	18"	18"
		39'-40'6"	D	9	10	11	Wet/v stiff		Gray silty CLAY, some fine sand (layered)	9	18"	18"

GROUND SURFACE TO 20' USED HW "CASING: THEN NW to Rock

Sample Type
D-Dry C-Cored W=Washed
UP-Undisturbed Piston
TP=Test Pit A-Auger V=Vane Test

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt. x 30" fall on 2" O.D. Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med. Dense; 30-50 Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 8-15 Stiff; 30 + Hard

SUMMARY
Earth Boring 104'
Rock Coring 7'
Samples 21

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 3

TO _____ ADDRESS _____

PROJECT NAME _____ LOCATION _____

REPORT SENT TO _____ PROJ. NO. _____

SAMPLES SENT TO _____ OUR JOB NO. 82-263

DATE _____

HOLE NO. B-105

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

t _____ after _____ Hours

t _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec.
		44'-45'6"	D	7	6	7	Wet stiff		Gray silty CLAY, some fine sand	10	18"	16"
								49'				
		49'-50'6"	D	6	6	9	"		Gray CLAY	11	18"	6"
		54'-55'6"	D	10	10	10	Wet very stiff			12	18"	18"
		59'-60'6"	D	7	9	13	"			13	18"	18"
		64'-65'6"	D	6	7	12	"			14	18"	18"
								69'				
		69'-70'6"	D	20	14	18	Wet dense		Gray silty fine SAND (compact), trace of clay	15	18"	18"
								74'				
		74'-75'6"	D	10	14	14	Wet/v stiff		Gray silty CLAY	16	18"	18"
		79'-80'6"	D	10	10	25	Wet Hard			17	18"	18"

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt. x 30" fall on 2" O.D. Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med. Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 30 + Hard

SUMMARY:
Earth Boring _____
Rock Coring _____
Samples _____

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 3 OF 3
DATE
HOLE NO. B-105
LINE & STA.
OFFSET
SURF. ELEV.

TO | ADDRESS
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
							Wet very stiff		Gray silty CLAY			
		84'-85'	D	11	19			85'		18	12"	12"
		85'-85'6"	D			51	Wet/v dense		Gray F-M SAND, Clay with	18A	6"	6"
								87'	little fine gravel			
								88'	Boulder			
							Wet		Gray clayey fine to medium			
		89'-90'6"	D	14	15	20	dense	90'6"	SAND, some fine gravel	19	18"	18"
							Wet					
		94'-95'6"	D	41	58	60	very dense		Gray weathered ARGILLITE	20	18"	6"
							Moist					
		99'-100'6"	D	59	89	100	very dense			21	18"	6"
							Min/Ft	104'				
		104'-106'	C				5			C1	24"	24"
							5					
		106'-111'	C				5			C2	60"	40"
							5					
							5					
							6					
							6	111'				
									Bottom of Boring 111'			

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring
Rock Coring
Samples

HOLE NO B-105

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 3
DATE
HOLE NO. B-106
LINE & STA.
OFFSET
SURF. ELEV. 16.8

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.
PROJECT NAME Marketplace Center | LOCATION Boston, Mass.
REPORT SENT TO above | PROJ NO. 4965
SAMPLES SENT TO " | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS
At 12'4" after 24 Hours
At ____ after ____ Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR
Type	HW	S/S	
Size I D	4"	1 3/8"	
Hammer Wt	300#	140#	BIT
Hammer Fall	24"	30"	

	Date	Time
START	4/1/82	a.m. p.m.
COMPLETE	4/2/82	a.m. p.m.
TOTAL HRS.		
BORING FOREMAN	J. Texeira	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								6"	Black Top			
		2'-3'6"	D	8	12	16	Wet medium dense		Yellow Clay mixed with Sand, Brick & Cinders FILL	1	18"	10"
		7'-8'6"	D	9	7	13	"			2	18"	1"
		9'-10'6"	D	5	7	11	"		Brown fine to coarse Gravel, little silt & coarse sand - FILL	3	18"	1"
		14'-15'6"	D	1	1	1	Wet loose		Gray Sand, Silt, Gravel & Cinders (mixed) - FILL	4	18"	8"
		19'-20'6"	D	1	1	1	"	20'6"		-	18"	0"
		20'6"-21'	D	3			W/soft	21'	Gray Organic SILT & Shells	5	6"	6"
		21'-22'6"	D	5	5	7	Moist		Blue CLAY	5A	18"	18"
		24'-26'	ST						(Tube was not good - Gravel in Yellow CLAY)	-	24"	22"
		29'-31'	ST							T1	24"	20"
		34'-35'	D	12	10		Moist very stiff	35'	Blue CLAY	6	12"	12"
		35'-35'6"	D			8	Wet medium stiff		Gray silty fine SAND, little clay	6A	6"	6"
		39'-40'6"	D	4	7	14	W/m/d			7	18"	18"

GROUND SURFACE TO ____ USED ____ "CASING. THEN ____ (layered)

Sample Type
D-Dry C Cored W Washed
UP Undisturbed Piston
TP-Test Pit A Auger V-Vane Test
HT Hollow Stem Auger

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring 91'
Rock Coring
Samples 16

HOLE NO B-106

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 3

TO _____ ADDRESS _____

PROJECT NAME _____ LOCATION _____

REPORT SENT TO _____ PROJ. NO. _____

SAMPLES SENT TO _____ OUR JOB NO. 82-263

DATE _____

HOLE NO. B-106

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								43'9"				
		44'-45'6"	D	5	7	8	Moist stiff		Blue CLAY	8	18"	18"
		@ 49'	D	100/0"				50'6"	(49'-50'6" - Boulder)			
		54'-55'6"	D	26	29	23	Wet/v dense		Gray clayey fine SAND (layered)	9	18"	18"
		59'-60'	D	12	24		Wet dense	60'		10	12"	12"
		60'-60'6"	D			14	Moist stiff		Blue CLAY, trace of very fine sand	10A	6"	6"
		64'-65'6"	D	17	33	52	Moist very dense	63'7"	Gray clayey fine SAND	11	18"	18"
		69'-70'6"	D	16	14	11	Wet very stiff	69'	Blue CLAY	12	18"	18"
		74'-75'6"	D	11	8	9	"			13	18"	18"
		79'-80'6"	D	7	7	10	"			14	18"	18"

GROUND SURFACE TO _____ USED _____ "CASING. THEN _____

Sample Type

D=Dry C=Cored W=Washed

UP=Undisturbed Piston

TP=Test Pit A=Auger V=Vane Test

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	
50 +	Very Dense	15-30	V-Stiff	

SUMMARY

Earth Boring _____

Rock Coring _____

Samples _____

HOLE NO. B-106

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 3 OF 3
DATE
HOLE NO. B-106
LINE & STA.
OFFSET
SURF. ELEV.

TO | ADDRESS
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								84'				
		84'-85'6"	D	25	30	34	Wet very dense		Gray clayey fine to medium SAND & Gravel	15	18"	12"
		89'-90'	D	39	59		"	90'		16		
		90'-91'	D	92	110		M/v/d	91'	Grav ARGILLITE (Bedrock)	16A	24"	16"
		@ 91'	D	120/0"					Refusal at 91'			
				300# Wt.								

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturced Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring _____
Rock Coring _____
Samples _____

HOLE NO. B-106

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 2

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-107

LINE & STA.

OFFSET

SURF. ELEV. 16.5

GROUND WATER OBSERVATIONS

At 10' after — Hours

10' Casing

At — after — Hours

	CASING	SAMPLER	CORE BAR
Rods - "NW"			
Type	HW-NW	S/S	
Size I D	4" 3"	1 3/8"	
Hammer Wt	300#/Drill	140#	BIT
Hammer Fall	24"	30"	

	Date	Time
START	3/29/82	a.m. p.m.
COMPLETE	3/30/82	a.m. p.m.
TOTAL HRS.		
BORING FOREMAN	G. Brouillette	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
									~~Black Top~~			
		4'-5'6"	D	5	5	4	Moist loose		Brown fine Sand & Clay, little fine gravel - FILL	1	18"	16"
		9'-9'6"	D	100			Wet/v dense	9'6"		2	6"	6"
									Granite Blocks & Brick FILL			
								13'				
		14'-15'6"	D	5	4	5	Wet loose		Black Organic SILT, tr. fine to medium Sand, Brick	3	18"	6"
		19'-20'6"	D	3	3	4	Wet medium stiff		Black Gray Organic SILT & fine Sand	4	18"	6"
		24'-25'6"	D	2	1	2	Wet soft		Gray Organic SILT, trace of sea shells	5	18"	18"
								27' -	Boulder			
		29'-30'6"	D	11	14	14	Wet very stiff		Brown CLAY, little fine to medium sand & gravel	6	18"	12"
								33'-	1' Boulder			
		34'-35'6"	D	5	6	11	"		" trace of coarse gravel (trace of wood)	7	18"	16"
								37' -	Cobbles			
		39'-41'	Push Shelby					39'	Gray CLAY	P1	24"	20"

GROUND SURFACE TO 10' USED HW "CASING. THEN NW to 34'

Sample Type
D: Dry C Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test
UT: Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring 55'6"
Rock Coring —
Samples 9

HOLE NO B-107

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 2
DATE
HOLE NO. B-107
LINE & STA.
OFFSET
SURF. ELEV.

TO | ADDRESS
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At ____ after ____ Hours

At ____ after ____ Hours

	CASING	SAMPLER	CORE BAR
Type			
Size I D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								43'	Gray CLAY			
		44'-45'6"	D	8	10	12				-	18"	0"
		47'-48'6"	D	20	60	26	Wet very dense		Gray silty fine SAND, trace of clay	8	18"	18"
		52'-53'6"	D	32	25	33	"	53'6"		9	18"	12"
									Bottom of Boring 53'6"			

GROUND SURFACE TO ____ USED ____ "CASING: THEN ____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring ____
Rock Coring ____
Samples ____

HOLE NO. B-107

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 2
DATE
HOLE NO. B-108
LINE & STA.
OFFSET
SURF. ELEV. 16.6

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.
PROJECT NAME Marketplace Center | LOCATION Boston, Mass.
REPORT SENT TO above | PROJ. NO. 4965
SAMPLES SENT TO " | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS
At -7' 3/31/82 after ___ Hours
At ___ after ___ Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR
Type	HW-NW	S/S	
Size I D	4" 3"	1 3/8"	
Hammer Wt	300#/Drill	140#	BIT
Hammer Fall	24"	30"	

	Date	Time
START	3/30/82	a.m. p.m.
COMPLETE	3/31/82	a.m. p.m.
TOTAL HRS.		

BORING FOREMAN G.Brouillette
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								4"	Black Top			
		6"-2'	D	8	15	12	Dry/m dense		Brown fine to medium Sand & Gravel - Brick - FILL	1	18"	6"
		4'-5'6"	D	6	7	8	Wet medium dense		Black Cinders, Brick, Silt & Sand - FILL (slag & cinders)	2	18"	6"
		9'-10'6"	D	10	15	50	Wet very dense			3	18"	6"
		14'-15'6"	D	2	1	2	Wet loose		" Brick - FILL	4	18"	6"
								17'				
		19'-20'6"	D	2	1	2	Wet soft		Gray Organic SILT, trace of sea shells	5	18"	18"
		24'-25'6"	D	1	1	1	"			6	18"	2"
								29'				
		29'-30'6"	D	12	29	30	Wet Hard	30'	Gray silty SAND, little fine to medium gravel cobbles & boulders	7	18"	12"
								34'	Gray sandy CLAY, tr. gravel			
		34'-35'6"	D	7	9	11	Wet very stiff		Yellow CLAY, trace of fine gravel cobbles	8	18"	12"
								38'				
		39'-40'6"	D	11	10	8	"		Gray CLAY	9	18"	16"

GROUND SURFACE TO 30' USED HW "CASING. THEN NW to 45'

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
		30 +	Hard

SUMMARY
Earth Boring 30'6"
Rock Coring ___
Samples 10.

HOLE NO B-108

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 2
DATE
HOLE NO. B-108
LINE & STA.
OFFSET
SURF. ELEV.

TO | ADDRESS
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								42'	Cobble			
		44'-46'	Push Shelby						Gray CLAY	P1	24"	21"
							Wet very stiff					
		49'-50'6"	D	7	8	11		50'6"		10	18"	18"
									Bottom of Boring 50'6"			

GROUND SURFACE TO _____ USED _____ "CASING. THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring
Rock Coring
Samples

HOLE NO. B-108

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 1

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-109 OW

LINE & STA.

OFFSET

SURF. ELEV. 16.9

GROUND WATER OBSERVATIONS

At ____ after ____ Hours

At ____ after ____ Hours

	Rods-"NW"	CASING	SAMPLER	CORE BAR
Type		HW	S/S	
Size I D		4"	1 3/8"	
Hammer Wt		300#	140#	BIT
Hammer Fall		24"	30"	

	Date	Time
START	4/2/82	a.m p.m
COMPLETE	4/5/82	a.m p.m
TOTAL HRS.		
BORING FOREMAN	J. Texeira	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
	10							6"	Black Top			
	13											
	16	2'-3'6"	D	3	6	7	Dry medium dense		Brown fine to medium Sand FILL	1	18"	12"
	19											
	20											
	28											
	32											
	39	7'-8'6"	D	6	6	7	"		(Wood Pile at 8' - Drill hole down pile to Refusal)	2	18"	9"
	46											
	15											
	18											
	39											
	30	12'-13'6"	D	10	18	18	Wet dense			3	18"	14"
	28											
	26											
	22											
	23											
	39											
	38	18'6"-20'	D	18	27	39	Wet/v dense			4	18'	9"
	240	(Wood)						20'				
									Refusal at 20'			
									HW Casing in Wood Pile			

GROUND SURFACE TO 20' USED HW "CASING: THEN Refusal on HW

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 20'
Rock Coring
Samples 4

HOLE NO B-109

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 1

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ NO. 4965

SAMPLES SENT TO " | OUR JOB NO 82-263

DATE

HOLE NO. B-109 OW A

LINE & STA.

OFFSET

SURF. ELEV. 16.9

GROUND WATER OBSERVATIONS

At 12' after Hours In Obs. Well

At after Hours

	Rods-"NW"	CASING	SAMPLER	CORE BAR.
Type		HW-NW	S/S	
Size I D		4" 3"	1 3/8"	
Hammer Wt		300#	140#	BIT
Hammer Fall		24"	30"	

	Date	Time
START	4/5/82	a.m p.m
COMPLETE	4/5/82	a.m p.m
TOTAL HRS.		
BORING FOREMAN	J. Texeira	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								0	Black Top			
		2'-3'6"	D	7	6	9	Dry medium dense		Brown fine to medium Sand, trace of medium gravel FILL	1	18"	18"
		7'-8'6"	D	7	8	13	"			2	18"	18"
		10'6"-12'6"	D	5	5	5	"		Rock Fragment	3	24"	2½"
						6		14'				
								15'	Rubble FILL			
		15'-16'6"	D	2	3	2	Wet loose		Black Brown silty fine to medium SAND (organic odor noted)	4	18"	6"
								18'				
								19'	Rubble FILL			
								20'				
									NW Casing broke off at 20' in Rubble FILL			
									Bottom of Boring 20'			
									Installed Observation Well 18'			
									1 Roadway Box			

GROUND SURFACE TO _____ USED _____ "CASING. THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring 20'
Rock Coring
Samples 4

HOLE NO B-109

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 2

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-110 OW

LINE & STA.

OFFSET

SURF. ELEV. 16.1

GROUND WATER OBSERVATIONS

At 6'4" after ___ Hours

At ___ after ___ Hours

	Rods-"NW"	CASING	SAMPLER	CORE BAR
Type		HW	S/S	
Size I D		4"	1 3/8"	
Hammer Wt			140#	BIT
Hammer Fall			30"	

	Date	Time
START	4/8/82	a.m. p.m.
COMPLETE	4/8/82	a.m. p.m.
TOTAL HRS.		
BORING FOREMAN	J. Texeira	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE- No	Pen	Rec
								0"	Black Top			
Drill		2'-3'6"	D	9	8	11	Moist medium dense		Brown medium Sand, Cinders FILL	1	18"	12"
								7'				
		7'-8'6"	D	12	16	17	Moist dense	9'7"	Red Brick, Sand & Wood FILL	2	18"	12"
		10'-11'6"	D	2	1	1	Wet soft		Gray Organic SILT	3	18"	18"
		14'-15'6"	D	1	1	2	"			4	18"	10"
								18'3"				
		19'-20'6"	D	7	13	22	Moist Hard		Yellow CLAY	-	18"	0"
		24'-25'6"	D	12	15	24	"			5	18"	18"
		29'-31'	ST							S1	24"	24"
								33'1"				
		34'-35'6"	D	3	3	5	Wet medium stiff		Blue silty CLAY	6	18"	18"

GROUND SURFACE TO ___ USED ___ "CASING: THEN ___

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	

SUMMARY:
Earth Boring 41'
Rock Coring
Samples 6

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 2
DATE
HOLE NO. B-110 OW
LINE & STA.
OFFSET
SURF. ELEV.

TO | ADDRESS
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ NO.
SAMPLES SENT TO | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I D			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
		39'-41'	ST					41'		S2	24"	24"
									Bottom of Boring 41'			
									Installed Observation Well 14'			
									1 Roadway Box			

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring
Rock Coring
Samples

HOLE NO B-110 OW

TOWN PRESS - EAST PROV

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 1
DATE
HOLE NO. B-111
LINE & STA.
OFFSET
SURF. ELEV. 16.4

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.
PROJECT NAME Marketplace Center | LOCATION Boston, Mass.
REPORT SENT TO above | PROJ. NO.
SAMPLES SENT TO " | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS
At 12'8" after ___ Hours
10' HW Casing
At ___ after ___ Hours

Rods-"NW"	CASING	SAMPLER	CORE BAR
Type	HW	S/S	
Size I D	4"	1 3/8"	
Hammer Wt		140#	BIT
Hammer Fall		30"	

	Date	Time
START	4/8/82	a.m. p.m.
COMPLETE	4/8/82	a.m. p.m.
TOTAL HRS.		
BORING FOREMAN	G.Brouillette	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
									Black Top			
		1'-2'6"	D	40	15	11	Moist/m dense		Brown fine to medium Sand, Silt, Gravel & Cobbles FILL	1	18"	12"
		4'-5'6"	D	20	29	40	Moist/v dense	6' - 8'	Brick & Wood - FILL	2	18"	6"
		9'-10'6"	D	3	3	3	Wet medium stiff		Black to Gray fine sandy Organic SILT, trace of sea shells & peat	3	18"	18"
		14'-15'6"	D	1	1	1	Wet soft	19'	Gray Organic SILT	4	18"	18"
		19'-20'6"	D	4	4	7	Wet stiff			5	18"	18"
		24'-26'	P	P U S H E D					Yellow CLAY	-	24"	0"
		27'-28'6"	D	7	8	10	Moist very stiff			6	18"	18"
		29'-31'	P	P U S H E D				33'		P1	24"	24"
		34'-35'6"	D	1	3	4	Wet medium stiff	37'	Gray silty CLAY	7	18"	18"
		39'-40'6"	D	15	19	19	Wet dense	40'6"	Gray silty fine to medium SAND & Gravel, little clay & coarse sand	8	18"	12"

GROUND SURFACE TO 20' USED HW "CASING. THEN Open Hole to Bottom of Boring

Sample Type
D: Dry C-Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test
UT: Undisturbed Thin-wall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt. x 30" fall on 2" O.D. Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med. Dense; 30-50 Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 8-15 Stiff; 30 + Hard

SUMMARY
Earth Boring 40'6"
Rock Coring
Samples 8

HOLE NO. B-111

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 2
DATE
HOLE NO. B-112
LINE & STA.
OFFSET
SURF. ELEV. 16.3

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.
PROJECT NAME Marketplace Center | LOCATION Boston, Mass.
REPORT SENT TO above | PROJ NO. 4965
SAMPLES SENT TO " | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS
At 12'4" after Hours
At after Hours

Rods - "NW"	CASING	SAMPLER	CORE BAR.
Type	HW	S/S	
Size I D	4"	1 3/8"	
Hammer Wt		140#	BIT
Hammer Fall		30"	

	Date	Time
START	4/5/82	a.m. p.m.
COMPLETE	4/5/82	a.m. p.m.
TOTAL HRS.		
BORING FOREMAN	J. Texeira	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
								3"	Black Top			
		2'-3'6"	D	8	9	11	Dry medium dense		Brown fine to medium Sand, trace of fine gravel - FILL	1	18"	-
								7'				
		7'-8'6"	D	6	9	3	"		Brown Sand, Cinders, Wood & Brick - FILL.	2	18"	18"
								13'				
		13'-14'6"	D	10	5	5	Wet stiff		Gray sandy Organic SILT, trace of shells	3	18"	18"
		19'-20'6"	D	3	5	7	"			4	18"	18"
		24'-25'6"	D	20	14	23	Wet Hard		" little fine to medium gravel	5	18"	8"
								26'				
		29'-30'6"	D	9	14	15	Moist/v stiff		Yellow CLAY	6	18"	18"
		31'-33'	ST						(Litt. medium gravel)	-	24"	0"
		34'-35'6"	D	9	9	8	"			7	18"	18"
								37'				
		39'-40'6"	D	5	6	8	Moist stiff		Blue CLAY, trace of coarse sand & fine gravel	8	18"	18"

GROUND SURFACE TO USED "CASING: THEN

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 45'6"
Rock Coring
Samples 9

HOLE NO B-112

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 2

TO _____ | ADDRESS _____

PROJECT NAME _____ | LOCATION _____

REPORT SENT TO _____ | PROJ. NO. _____

SAMPLES SENT TO _____ | OUR JOB NO. 82-263

DATE _____

HOLE NO. B-112

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING: _____

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
		44'-45'6"	D	4	5	6	Moist stiff	45'6"	Gray CLAY	9	18"	18"
									Bottom of Boring 45'6"			

GROUND SURFACE TO _____ USED _____ "CASING: THEN _____

Sample Type

D=Dry C=Cored W=Washed

UP=Undisturbed Piston

TP=Test Pit A=Auger V=Vane Test

UT=Undisturbed Thinwall

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:

Earth Boring _____

Rock Coring _____

Samples _____

HOLE NO B-112

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF 3

TO Haley & Aldrich, Inc. | ADDRESS Cambridge, Mass.

PROJECT NAME Marketplace Center | LOCATION Boston, Mass.

REPORT SENT TO above | PROJ. NO. 4965

SAMPLES SENT TO " | OUR JOB NO. 82-263

DATE

HOLE NO. B-113

LINE & STA.

OFFSET

SURF. ELEV. 16.6

GROUND WATER OBSERVATIONS

At 12' after 0 Hours
10' Casing

At ____ after ____ Hours

	Rods-"NW"	CASING	SAMPLER	CORE BAR
Type		HW-NW	S/S	
Size I D		4" 3"	1 3/8"	
Hammer Wt		Drill	140#	BIT
Hammer Fall			30"	

	Date	Time
START	3/31/82	a.m p.m
COMPLETE	4/1/82	a.m p.m
TOTAL HRS.		

BORING FOREMAN G.Brouillette

INSPECTOR

SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec.
								3"	Black Top			
		1'-2'6"	D	5	20	15	Dry dense		Brown fine to medium Sand, some gravel - FILL	1	18"	12"
		4'-5'6"	D	14	10	9	Wet medium dense			2	18"	12"
								9'	Wood			
		9'-10'6"	D	5	2	2	Wet soft		Gray Organic SILT, trace of sea shells	3	18"	12"
								13'	Wood			
		14'-15'6"	D	1	2	2	"			4	18"	14"
								18'6"				
		19'-20'6"	D	5	7	10	Moist very stiff		Yellow Brown CLAY	5	18"	18"
		24'-25'6"	D	6	6	10	"			6	18"	18"
		29'-31'	Push Shelby						Gray CLAY, trace of silt	P1	24"	20"
		34'-35'6"	D	3	4	6	Wet stiff			7	18"	16"
		39'-40'6"	D	4	6	6	"		trace of fine sand	8	18"	18"

GROUND SURFACE TO 9' USED HW "CASING: THEN NW to 24' - Open to Bottom

Sample Type
D: Dry C: Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt. x 30" fall on 2" O.D. Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med Dense; 30-50 Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 30 + Hard

SUMMARY
Earth Boring 95'
Rock Coring
Samples 17

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 2 OF 3

TO _____ | ADDRESS _____

PROJECT NAME _____ | LOCATION _____

REPORT SENT TO _____ | PROJ. NO. _____

SAMPLES SENT TO _____ | OUR JOB NO. 82-263

DATE _____

HOLE NO. B-113

LINE & STA. _____

OFFSET _____

SURF. ELEV. _____

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		

BORING FOREMAN _____

INSPECTOR _____

SOILS ENGR. _____

LOCATION OF BORING _____

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
		44'-45'6"	D	3	4	7	Wet stiff		Gray silty CLAY, trace of fine sand	9	18"	18"
		49'-50'6"	D	3	8	12	Wet very stiff	53'		10	18"	16"
		54'-55'6"	D	13	17	27	Wet dense		Gray silty fine SAND, trace of clay	11	18"	12"
		59'-60'6"	D	12	14	21	"			12	18"	9"
		64'-65'6"	D	20	22	28	"	68'	Gray fine SAND, some silt	13	18"	16"
		69'-70'6"	D	7	8	8	Wet very stiff		Gray CLAY	14	18"	16"
		74'-75'6"	D	11	11	11				-	18"	0"
		79'-80'6"	D	16	21	57	Wet/v dense	79'	Gray fine to medium SAND, Clay & Gravel	15	18"	16"

GROUND SURFACE TO _____ USED _____ "CASING. THEN _____

Sample Type

D=Dry C=Cored W=Washed

UP=Undisturbed Piston

TP=Test Pit A=Auger V=Vane Test

UT=Undisturbed Thinwall

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	
50 +	Very Dense	15-30	V-Stiff	

SUMMARY

Earth Boring _____

Rock Coring _____

Samples _____

HOLE NO B-113

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 3 OF 3
DATE
HOLE NO. B-113
LINE & STA.
OFFSET
SURF. ELEV.

TO | ADDRESS
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO | OUR JOB NO. 82-263

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR
Type			
Size I.D.			
Hammer Wt			BIT
Hammer Fall			

	Date	Time
START		a.m. p.m.
COMPLETE		a.m. p.m.
TOTAL HRS.		
BORING FOREMAN		
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
									Gray fine to medium SAND, Silt, Clay & Gravel			
		84'-85'6"	D	15	31	54	Wet	85'		16	18"	18"
							very		Gray weathered ARGILLITE			
							dense					
		89'-90'6"	D	20	135	100	"			17	18"	12"
								95'				
		@ 95'	D	100/0"					Bottom of Boring 95' Refusal			

GROUND SURFACE TO _____ USED _____ "CASING. THEN _____

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY
Earth Boring
Rock Coring
Samples

HOLE NO B-113

APPENDIX C

Groundwater Observation Well Reports and Readings

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

GROUND WATER MONITORING REPORT

OW/PZ NUMBER: OW-1 (B-103A) ELEVATION SUBTRAHEND 15.6 FILE NO. 4965
PAGE NO. 1 of 1

DATE	TIME	ELAPSED TIME	DEPTH OF WATER FROM Ground ~~Surface~~	ELEVATION OF WATER	REMARKS	READ BY
3-29-82	0700	72 hrs.	7.9	7.7		ABJ
3-30-82	0700	96 hrs.	8.2	7.4		ABJ
3-30-82	1300	102 hrs.	8.4	7.2		ABJ
3-31-82	0700	120 hrs.	8.2	7.4		ABJ
3-31-82	1435	128 hrs.	8.3	7.3		ABJ
4-01-82	0700	144 hrs.	6.2	9.4	Following heavy rain	ABJ
4-05-82	1000	10 days	8.3	7.3		ABJ
4-08-82	--	--	--	--	No reading due to snow cover	ABJ
5-04-82	--	--	--	--	Unable to locate	RS
5-11-82	--	--	--	--	Unable to locate	EW
5-13-82	0700	48 days	8.3	7.3		ABJ
6-07-82	--	--	--	--	Unable to locate	DBG

H&A FORM JAN. 79 59A

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

GROUND WATER MONITORING REPORT

OW/PZ NUMBER: OW-2 (B-101A) | ELEVATION SUBTRAHEND 15.6 | FILE NO. 4965 | PAGE NO. 1 of 1

DATE	TIME	ELAPSED TIME	DEPTH OF WATER FROM Ground Surface	ELEVATION OF WATER	REMARKS	READ BY
3-30-82	0700	16 hrs.	10.0	5.6	Initial reading	ABJ
3-30-82	1300	22 hrs.	10.3	5.3		ABJ
3-31-82	0700	40 hrs.	10.2	5.4		ABJ
3-31-82	1435	47 hrs.	10.2	5.4		ABJ
4-01-82	0700	64 hrs.	10.0	5.6	Following heavy rain.	ABJ
4-05-82	1000	7 days	10.0	5.6		ABJ
4-08-82	--	--	--	--	No reading due to snow cover	ABJ
5-04-82	1300	36 days	10.0	5.6		RS
5-11-82	1030	42 days	9.6	6.0		EW
6-07-82	1400	69 days	8.3	7.3	After 8-1/2 inches of rain in 7 days	DBG

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

GROUND WATER MONITORING REPORT

OW/PZ NUMBER: OW-3 (B-109A)

ELEVATION SUBTRAHEND 16.9

FILE NO. 4965

PAGE NO. 1 of 1

DATE	TIME	ELAPSED TIME	DEPTH OF WATER FROM Ground ~~Surface~~	ELEVATION OF WATER	REMARKS	READ BY
4-05-82	1400	0	12.3	4.6	Initial reading	ABJ
4-06-82	1000	20 hrs.	10.6	6.3		ABJ
4-08-82	0900	3 days	13.8	3.1		ABJ
5-04-82	1340	29 days	12.1	4.8		RS
5-11-82	1030	36 days	13.5	3.4		EW
6-07-82	1400	63 days	8.6	8.3	After 8-1/2 inches of rain in 7 days	DBG

H&A FORM JAN. 79 59A

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

GROUND WATER MONITORING REPORT

OW/PZ NUMBER: OW-4 (B-110) ELEVATION SUBTRAHEND 16.1 FILE NO. 4965
PAGE NO. 1 of 1

DATE	TIME	ELAPSED TIME	DEPTH OF WATER FROM Ground Surface	ELEVATION OF WATER	REMARKS	READ BY
4-08-82	1445	0	6.3	9.8	Initial reading after flush	ABJ
5-04-82	1320	26 days	7.5	8.6		RS
5-11-82	1100	33 days	6.9	9.2		EW
6-07-82	1400	60 days	6.9	9.2	After 8-1/2 inches of rain in 7 days	DBG

HALEY & ALDRICH, INC.
CONSULTING SOIL ENGINEERS

GROUND WATER OBSERVATION WELL REPORT

PROJECT: MARKETPLACE CENTER
LOCATION: BOSTON, MASSACHUSETTS
CLIENT: MR. JAMES F. SULLIVAN
CONTRACTOR: GUILD DRILLING COMPANY, INC.
DRILLER: J. Texeira INSPECTOR: A. BarJosef
INSTALLATION DATE 3-26-82

FILE NO. 4965
WELL NO. OW-1
BORING NO. B-103A
LOCATION See Plan
SHEET 1 OF 1

SURVEY DATUM

GROUND ELEVATION 15.6

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

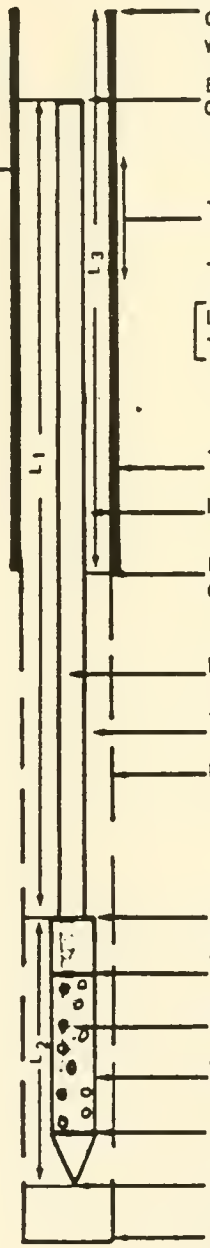
7.0

ORGANIC SILT

24.0

PEAT

25.0



ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF CASING OR ROADWAY BOX	0.0
ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF RISER PIPE.	1.0 inch
THICKNESS OF SURFACE SEAL	0.8 ft.
TYPE OF SURFACE SEAL	Cement
[INDICATE ALL SEALS SHOWING DEPTH, THICKNESS AND TYPE]	
TYPE OF CASING	Roadway Box
INSIDE DIAMETER OF CASING	2.5 inch
ELEVATION/DEPTH OF BOTTOM OF CASING	2.4 ft.
INSIDE DIAMETER OF RISER PIPE	1.5 inch
TYPE OF BACKFILL AROUND RISER	Ottawa Sand
DIAMETER OF BOREHOLE	4.0 inch
ELEVATION/DEPTH OF BOTTOM OF RISER	10.0 ft.
TYPE OF POINT OR MANUFACTURER	PVC
SCREEN GAUGE OR SIZE OF OPENINGS	Machine Slotted
DIAMETER OF WELLPOINT	1.5 inch
TYPE OF BACKFILL AROUND POINT	Ottawa Sand
ELEVATION/DEPTH OF BOTTOM OF POINT	15.0 ft.
ELEVATION/DEPTH OF BOTTOM OF BOREHOLE	104.5 ft.

[FIGURES REFER TO: EL. ____ DEPTH X]

[____ LENGTH OF CASING L_3] [5.0 LENGTH OF RISER PIPE (L_1) + 10.0 LENGTH OF POINT (L_2) = 15.0 PAY LENGTH]

M&A FORM 59 SEP 72

HALEY & ALDRICH, INC.
CONSULTING SOIL ENGINEERS

GROUND WATER OBSERVATION WELL REPORT

PROJECT: MARKETPLACE CENTER
LOCATION: BOSTON, MASSACHUSETTS
CLIENT: MR. JAMES F. SULLIVAN
CONTRACTOR: GUILD DRILLING COMPANY, INC.
DRILLER: G. Brouillette INSPECTOR: A. BarJosef
INSTALLATION DATE 3-29-82

FILE NO. 4965
WELL NO. OW-2
BORING NO. B-101A
LOCATION See Plan
SHEET 1 OF 1

SURVEY DATUM

GROUND ELEVATION 15.6

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

WOOD

18.0

Silty CLAY

ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF CASING OR ROADWAY BOX	0.0
ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF RISER PIPE.	3.0 inch
THICKNESS OF SURFACE SEAL	0.6 ft.
TYPE OF SURFACE SEAL	Cement
[INDICATE ALL SEALS SHOWING DEPTH, THICKNESS AND TYPE]	
TYPE OF CASING	Roadway Box
INSIDE DIAMETER OF CASING	2.5 inch
ELEVATION/DEPTH OF BOTTOM OF CASING	2.4 ft.
INSIDE DIAMETER OF RISER PIPE	1.5 inch
TYPE OF BACKFILL AROUND RISER	Peastone
DIAMETER OF BOREHOLE	4.0 inch
ELEVATION/DEPTH OF BOTTOM OF RISER	10.0 ft.
TYPE OF POINT OR MANUFACTURER	PVC
SCREEN GAUGE OR SIZE OF OPENINGS	Machine Slotted
DIAMETER OF WELLPOINT	1.5 inch
TYPE OF BACKFILL AROUND POINT	Ottawa Sand
ELEVATION/DEPTH OF BOTTOM OF POINT	20.0 ft.
ELEVATION/DEPTH OF BOTTOM OF BOREHOLE	109.0 ft.

[FIGURES REFER TO: EL. ____ DEPTH X]

[LENGTH OF CASING L_3]	[LENGTH OF RISER PIPE (L_1)]	+	LENGTH OF POINT (L_2)	=	PAY LENGTH]
	10.0	+	10.0	=	20.0

H&A FORM SEP 72 59

HALEY & ALDRICH, INC.
CONSULTING SOIL ENGINEERS

GROUND WATER OBSERVATION WELL REPORT

PROJECT: MARKETPLACE CENTER
LOCATION: BOSTON, MASSACHUSETTS
CLIENT: MR. JAMES F. SULLIVAN
CONTRACTOR: GUILD DRILLING COMPANY, INC.
DRILLER: J. Texeira INSPECTOR: A. BarJosef
INSTALLATION DATE 4-05-82

FILE NO. 4965
WELL NO. OW-3
BORING NO. B-109A
LOCATION See Plan
SHEET 1 OF 1

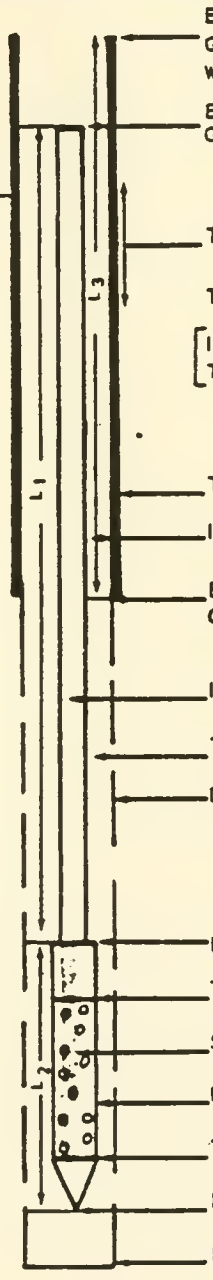
SURVEY DATUM

GROUND ELEVATION 16.9

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

18.0
FILL
20.0



ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF CASING OR ROADWAY BOX	0.0
ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF RISER PIPE.	2.0 inch
THICKNESS OF SURFACE SEAL	0.5 ft.
TYPE OF SURFACE SEAL	Cement
[INDICATE ALL SEALS SHOWING DEPTH, THICKNESS AND TYPE]	
TYPE OF CASING	Roadway Box
INSIDE DIAMETER OF CASING	2.5 inch
ELEVATION/DEPTH OF BOTTOM OF CASING	2.4 ft.
INSIDE DIAMETER OF RISER PIPE	1.5 inch
TYPE OF BACKFILL AROUND RISER	Peastone
DIAMETER OF BOREHOLE	4.0 inch
ELEVATION/DEPTH OF BOTTOM OF RISER	8.0 ft.
TYPE OF POINT OR MANUFACTURER	PVC
SCREEN GAUGE OR SIZE OF OPENINGS	Machine Slotted
DIAMETER OF WELLPOINT	1.5 inch
TYPE OF BACKFILL AROUND POINT	Ottawa Sand
ELEVATION/DEPTH OF BOTTOM OF POINT	18.0 ft.
ELEVATION/DEPTH OF BOTTOM OF BOREHOLE	20.0 ft.

[FIGURES REFER TO: EL. ____ DEPTH X]

[____ LENGTH OF CASING L_3] [8.0 LENGTH OF RISER PIPE (L_1) + 10.0 LENGTH OF POINT (L_2) = 18.0 PAY LENGTH]

H&A FORM 59 SEP. 72

HALEY & ALDRICH, INC.
CONSULTING SOIL ENGINEERS

GROUND WATER OBSERVATION WELL REPORT

PROJECT: MARKETPLACE CENTER
LOCATION: BOSTON, MASSACHUSETTS
CLIENT: MR. JAMES F. SULLIVAN
CONTRACTOR: GUILD DRILLING COMPANY, INC.
DRILLER: J. Texeira INSPECTOR: A. BarJosef
INSTALLATION DATE 4-08-82

FILE NO. 4965
WELL NO. OW-4
BORING NO. B-110
LOCATION See Plan
SHEET 1 OF 1

SURVEY DATUM

GROUND ELEVATION 16.1

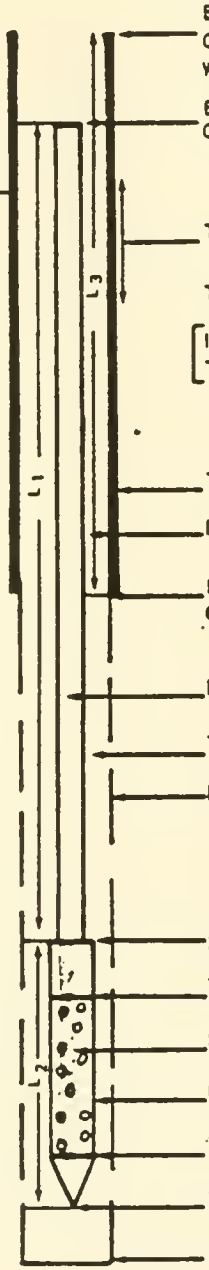
SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

9.7

ORGANIC SILT

18.0



ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF CASING OR ROADWAY BOX	0.0
ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF RISER PIPE.	2.0 inch
THICKNESS OF SURFACE SEAL	0.5 ft.
TYPE OF SURFACE SEAL	Blacktop
[INDICATE ALL SEALS SHOWING DEPTH, THICKNESS AND TYPE]	
TYPE OF CASING	Roadway Box
INSIDE DIAMETER OF CASING	2.5 inch
ELEVATION/DEPTH OF BOTTOM OF CASING	2.4 ft.
INSIDE DIAMETER OF RISER PIPE	1.5 inch
TYPE OF BACKFILL AROUND RISER	Peastone
DIAMETER OF BOREHOLE	3.0 inch
ELEVATION/DEPTH OF BOTTOM OF RISER	4.0 ft.
TYPE OF POINT OR MANUFACTURER	PVC
SCREEN GAUGE OR SIZE OF OPENINGS	Machine Slotted
DIAMETER OF WELLPOINT	1.5 inch
TYPE OF BACKFILL AROUND POINT	Ottawa Sand
ELEVATION/DEPTH OF BOTTOM OF POINT	14.0 ft.
ELEVATION/DEPTH OF BOTTOM OF BOREHOLE	41.0 ft.

[FIGURES REFER TO: EL. ____ DEPTH X]

[____ LENGTH OF CASING L_3] [4.0 LENGTH OF RISER PIPE (L_1) + 10.0 LENGTH OF POINT (L_2) = 14.0 PAY LENGTH]

H&A FORM 59 SEP. 72

7370 003

BOSTON PUBLIC LIBRARY
3 9999 06314 936 1